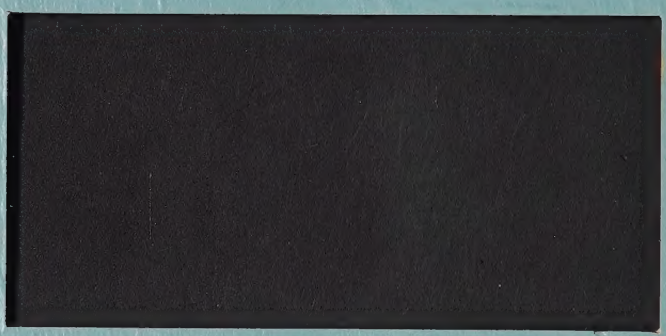
MODEL 11

INSTRUCTIONS
FOR

DANA* DIGITAL ACCESSORIES

1 - PREAMPLIFIER
2 - OHMS CONVERTER
3 - AC CONVERTER
4 - INPUT FILTERS

DANA



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Publication DL-404-1

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DANA Laboratories, Inc.
Irvine, California
December - 1965

Telephone (714) 833-1234
Teletype (910) 595-1136

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INSTRUCTIONS

FOR

DC PREAMPLIFIER

MODEL 11

INTRODUCTION

The Dana Model 11 DC Preamplifier is a signal conditioning plug-in circuit card for use with Dana Series 5600 Digital Voltmeter, (DVM).

When inserted in a DVM which is properly wired, it allows millivolt signals to be measured with the normal voltmeter leads. The Model 11 is contained within and derives its power supply voltages from the DVM. The guarded input characteristics of the Dana DVM are retained for millivolt measurements. Full one digit resolution is maintained when the preamplifier is used.

SPECIFICATIONS

Model 11 - D. C. Preamplifier

Function	Amplifies very small DC signals to increase the sensitivity of the DVM; all specifications refer to DVM output as a function of input voltage
Full Scale	9.9999, 99.999, 999.99 millivolts
Accuracy	±0.02% of reading or ± 0.01% of f.s.
Zero stability	± 5 microvolts
Response Time (to 0.01%)	
Step response	1 second
Response with range change	3 seconds
Input resistance	100 megohms minimum
Common Mode Rejection, dc to 60 cps	at least 130 db with up to 1000 ohms in either lead
Resolution on Most Sensitive Range	0.1 microvolt per digit (Series 5600 DVM)
Range Control	Automatic with manual override, selected by DVM front panel knob
Decimal Point Indication	Automatic; displayed in millivolts
Function Control	Preamplifier is inserted between signal and DVM by selecting "millivolt" position of function selector
Measuring Time	DC voltage measuring time plus 1 second on fixed range and polarity; DC measuring time plus 3 seconds worst case polarity and range change
Isolation	Preamplifier input is isolated and guarded from ground, AC power line and electrical output
Size and Mounting	Preamplifier is wholly enclosed within Dana Series 5600 DVM; there are no additional cables, connectors, or controls

DESCRIPTION

The Dana Model 11 DC preamplifier is a standard accessory for use with Dana 5600 Series DVM's. Solid state circuitry is used throughout and a precision mechanical modulator assures low drift characteristics. The three automatic or manually selected ranges are factory set for maximum accuracy and long-term stability is assured by the use of premium, highly stable feedback resistors. No periodic field adjustments are required.

All circuitry is contained on a single printed circuit card that can be conveniently inserted into its prewired position in the DVM and placed in operation immediately. No preliminary adjustments are required.

OPERATION

When the Model 11 is installed in a Dana DVM, millivolt measuring capability is available using the normal input leads. Operation of the DVM for millivolt measurements is much the same as for standard DC measurements, since the normal guarded input circuit, and all automatic features are available.

To activate the preamplifier, the function switch is placed in the "Millivolt" position. Automatic ranging may then be selected as in standard DC operation, or if desired, the instrument may be manually placed on the 10, 100, or 1000 millivolt position. The 1 millivolt range is not operational and should not be used as this position of the range switch is used only with AC Converters and Ohms Converters.

Either of the standard mode positions may be selected when measuring millivolts; however, they will react, or in some cases appear to react, somewhat differently. These differences are described below.

Periodic - When polarity and range changes are not required, operation will be normal and periodic measurements will be made at the repetition rate determined by the specific DVM is use; however, when a range or polarity change occurs, the "time out" circuits in the DVM (set for approximately 1.0 seconds in "Millivolt" function), will inhibit read commands to permit the preamplifier to settle and avoid erroneous readings.

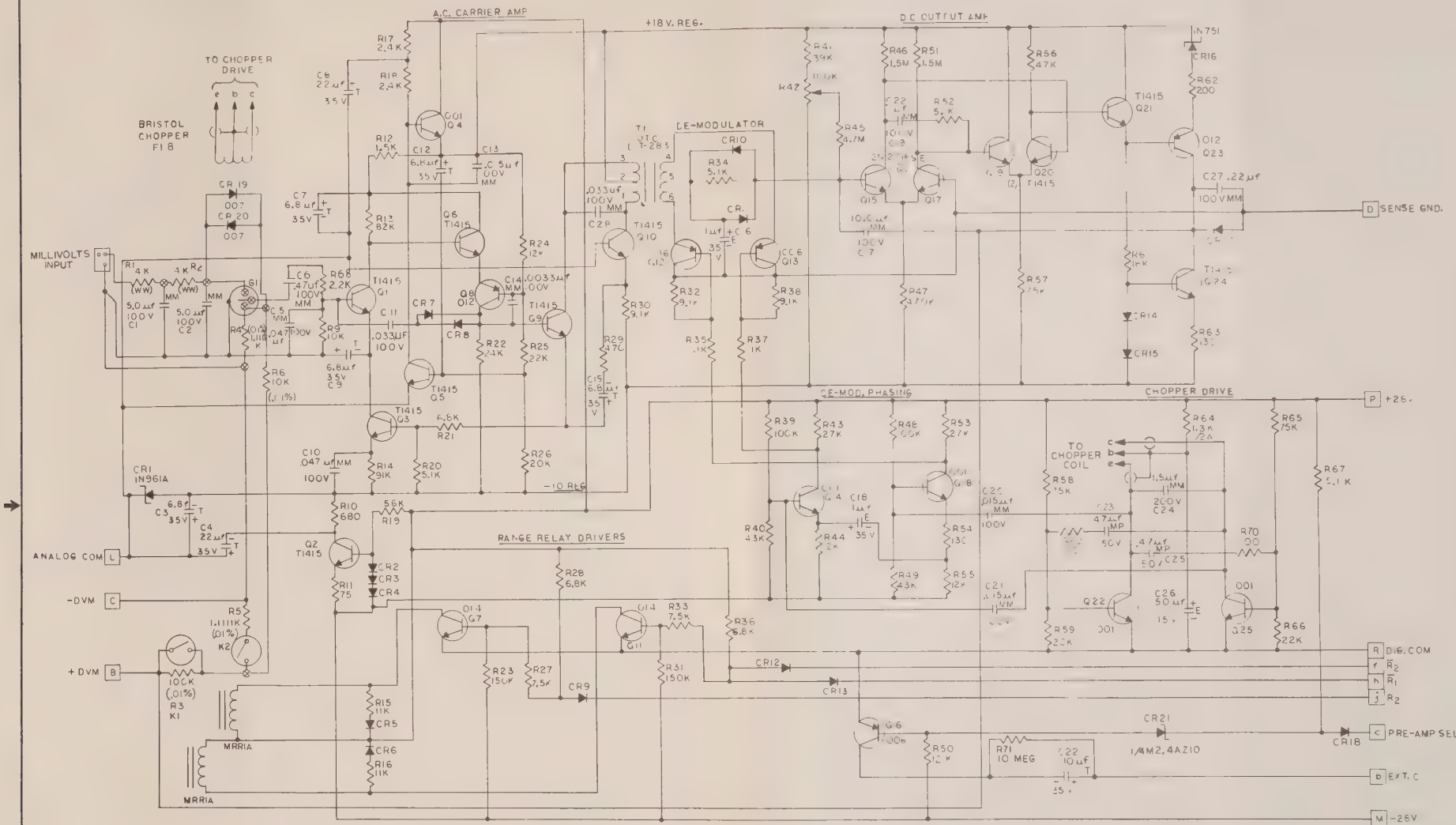
Tracking - In Tracking mode, the DVM will track the input signal as described in section 5.11 of the Model 5600 Instruction Manual. If the input voltage shifts more than one digit for the duration of the variable sensing period, a new reading will be taken.

The preamplifier is factory adjusted for minimum offset. However, the operator may wish to readjust the zero control occasionally to compensate for thermal potentials generated in a given test setup. The zero control is located on the front of the Preamplifier, readily accessible behind the right front panel section. The card is located in card position number 22 (fifth card position from extreme right). The adjustment should be made only after the DVM and all associated input circuits have achieved thermal stability. To illustrate the importance of the latter, set the DVM to the 10 millivolt range and short the input probes. After the instrument has arrived at a balanced condition, take hold of the test probes and observe the change in reading as the test probes heat.

The Model 11 was designed for on-the-line applications, and therefore, is as foolproof as is consistent with performance requirements. Fusing being impractical due to thermal problems, the instrument was designed to withstand sustained overloads up to 10 volts. Although higher voltages can be tolerated for short periods of time, the operator should exercise care to see that the 10 volt rating is not exceeded.

PREAMPLIFIER PARTS LIST
MODEL 11
Less 5% Carbon Resistors

PART NO.	DESCRIPTION	QTY	REC'D SPARES	APPROX. PRICE
RESISTORS				
020057	Resistor - 1.1111K, .01%, 5ppm EP-21, Wirewound	2	1	15.00
020058	4K, 3$, Wirewound	2	1	2.75
021397	10K, .01%, Wirewound 5ppm	1	1	8.00
021398	100K, .01%, Wirewound, 5ppm	1	1	12.00
040004	Potentiometer - 100K, Bourns, E-Z Trim	1	1	4.00
CAPACITORS				
110001	6.8uf, 35V, Tantalum	6	1	2.40
110002	22uf, 35V, Tantalum	2	1	3.80
110017	1uf, 35V, Tantalum	2	1	1.60
110020	10uf, 35V, Tantalum	1	1	4.30
111096	50uf, 15V, Electrolytic	1	1	1.15
120001	.0033uf, 100V, Mylar	1	1	.30
120006	.47uf, 50V, Metalized Paper, Electrocube	2	1	2.40
120016	5uf, 100V, Mylar, El Pac	2	1	9.00
120018	.47uf, 200V, Mylar	1	1	2.60
120020	10uf, 100V, Mylar, El Pac Special	1	1	18.50
120025	1.5uf, 100V, ±10%, Capco or CDE	1	1	6.60
120026	.47uf, 100V, ±10%, Capco or CDE	1	1	2.60
121090	.015uf, 100V, Mylar	3	1	.30
121091	.033uf, 100V, Mylar	1	1	.25
121093	.047uf, 100V, Mylar	2	1	.25
121393	.22uf, 100V, Mylar	1	1	.60
121468	.022uf, 100V, Mylar	1	1	.25
TRANSISTORS				
200006	Type TI 415	11	1	1.75
200013	Matched Pair, TI 415, Spec Selected	1 pr	1 pr	1.75
200022	Type 012, Dana	3	1	4.50
201085	Type 005, Dana	2	1	1.60
201109	Type 001, Dana, Raytheon Type	5	1	3.50
201111	Type 006, Dana	2	1	10.00
211083	Diode - IN662	16	2	.50
211236	Diode - Low Leakage, Type 007	2	1	.90
220007	Diode - Zener, IN751	1	1	6.50
221177	Diode - Zener, 1/4M2.4AZ10, 2.4V	1	1	2.25
221254	Diode - Zener, IN961A, 10V, ±10%	1	1	7.50
300001	Transformer - 10K (Center Tap) to 10K Center Tap), United #DI-T-283	1	1	21.45
310003	Relay - 24V, Dunco #MRRIA	2	1	12.00



NOTES: UNLESS OTHERWISE NOTED
1. ALL DIODES IN662.
2. ALL RESISTORS 1/4W 5%.
3. CAPACITOR CODE:
   E = ELECTROLYTIC
   T = TANTALUM
   MM = METALLIZED MYLAR
   MP = METALLIZED PAPER
4. ⊗ = LOW THERMAL SOLDER.

NOTES:

QTY REQD	SYM	ITEM NO	GOVT IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS X = .030, XX = .020, XXX = .010
ANG. ES ± 0° 30'

MATERIAL .031

APPLIED FINISH NONE

DRAWN	J. Eder	9 Oct 74
CHECK	T-f-f	10-9-74
ENGR		
APPR		

APPROVED

APPROVED

REL 23 Oct 74
DRN 6 3 X-7

DANA LABORATORIES INC.
SANTA ANA, CALIF.

SCHEMATIC —
PRE-AMP, DVM

CODE IDENT NO. | SIZE D | 430209 | D

SCALE 1.5/1 | WEIGHT | SHEET 1 of 1

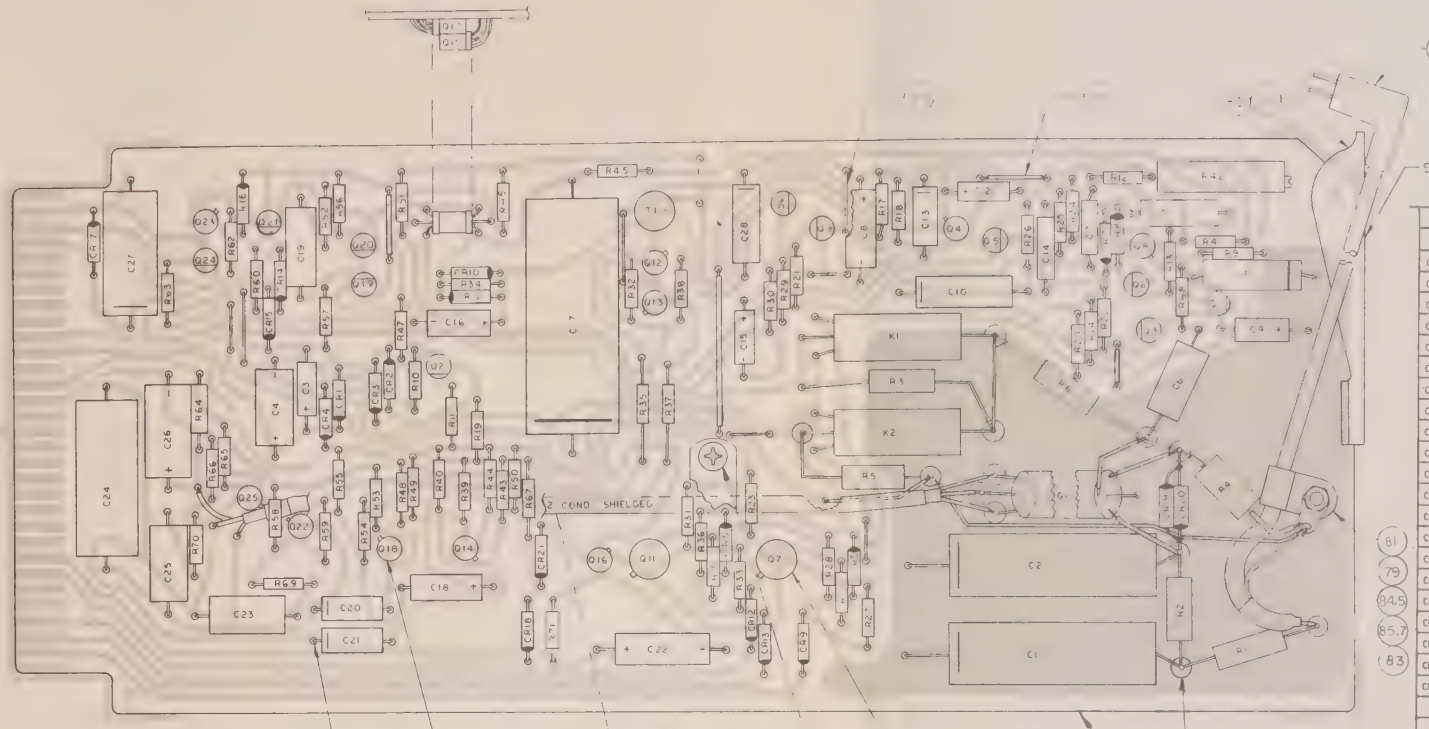
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
406112		REF	REF

APPLICATION | QTY REQD

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA — SUB-ASSY MRA — MAJOR REPL ASSY
MA — MODULE ASSY CA — COMPLETE ASSY

D 430209

888-00 LIETZ 1118 TOPFLIGHT 10-63



REF DES	B/M ITEM	DESCRIPTION
CR21	66	1/4 2.4AZ10
CR20	64	.007
CR19	64	.007
CR18	63	1N662
CR17	63	1N662
CR16	65	1N751
CR15	63	1N662
CR14	63	1N662
CR13	63	1N662
CR12	63	1N662
CR11	63	1N662
CR10	63	1N662
CR 9	63	1N662
CR 8	63	1N662
CR 7	63	1N662
CR 6	63	1N662
CR 5	63	1N662
CR 4	63	1N662
CR 3	63	1N662
CR 2	63	1N662
CR 1	67	1N961A
C 28	53	.033 MFD
C 27	55	.22 MFD
C 26	44	50 MFD
C 25	46	47 MFD
C 24	50	1.5 MFD
C 23	46	.47 MFD
C 22	43	10 MFD
C 21	52	.015 MFD
C 20	57	.015 MFD
C 19	56	.022 MFD
C 18	42	1.0 MFD
C 17	49	10.0 MFD

REF DES	B/M ITEM	DESCRIPTION
Q 25	61	301
Q 24	57	TI 415
Q 23	59	012
Q 22	61	001
Q 21	57	TI 415
Q 20	57	TI 415
Q 19	57	TI 415
Q 18	61	001
Q 17	58	2N2716SE
Q 16	62	006
Q 15	58	2N2716SE
Q 14	61	001
Q 13	62	006
Q 12	62	006
Q 11	59.5	014
Q 10	57	TI 415
Q 9	57	TI 415
Q 8	59	012
Q 7	59.5	014
Q 6	57	TI 415
Q 5	57	TI 415
Q 4	61	001
Q 3	57	TI 415
Q 2	57	TI 415
Q 1	57	TI 415
K 2	67	24 V
K 1	69	24 V
G 1	70	400 Cycle

REF DES	B/M ITEM	DESCRIPTION
R 17	4	11 K
R 16	4	11 K
R 15	4	11 K
R 14	33	91 K
R 13	31	82 K
R 12	7	1.5 K
R 11	28	75 K
R 10	26	680
R 9	2	10 K
R 8	37	10 K .01%
R 7	35	1.1111K .01%
R 6	34	1.1111K .01%
R 5	36	100 K 1%
R 4	36	4 K 1%
R 3	36	100 K 1%
R 2	36	4 K 1%
R 1	36	4 K 1%

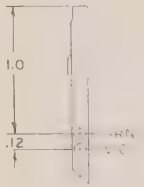
REF DES	B/M ITEM	DESCRIPTION
J 1	68	10K to 10 K
P 71	3.5	10 Meg
P 70	1	100
P 69	1	100
R 68	13	2.2 K
P 67	24	5.1 K
P 66	14	22 K
P 65	30	75 K
P 64	34	1.3 K 1/2W
P 63	6	130
R 62	11	200
P 60	10	18 K
P 59	14	22 K
P 58	30	75 K
P 57	30	75 K
P 56	21	47 K
P 55	5	12 K
P 54	6	130
P 53	17	27 K
P 52	24	5.1 K
P 51	9	1.5 Meg
P 50	5	12 K
P 49	19	43 K
P 48	3	100 K
P 47	22	470 K
P 46	9	1.5 M
P 45	23	4.7 M
P 44	5	12 K
P 43	17	27 K
P 42	39	100 K Pot
P 41	18	39 K
P 40	19	43 K
P 39	3	100 K
P 38	32	9.1 K

REF DES	B/M ITEM	DESCRIPTION
C 8	41	22 MFD
C 7	40	6.8 MFD
C 6	51	.47 MFD 100V
C 5	54	.047 MFD
C 4	41	22 MFD
C 3	40	6.8 MFD
C 2	47	5.0 MFD
C 1	47	5.0 MFD

REF DES	B/M ITEM	DESCRIPTION
C 16	42	1.0 MFD
C 15	40	6.8 MFD
C 14	45	.0033 MFD
C 13	52	.015 MFD
C 12	40	6.8 MFD
C 11	53	.033 MFD
C 10	54	.047 MFD
C 9	40	6.8 MFD

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
74	450389
75	451036
76	500003
77	500004
78	501376
79	500422
80	610019
81	610050
82	611435
83	611630
84.5	615059
85.4	617375
85.7	617[illegible]
88	[illegible]
89	[illegible]
90	[illegible]
91	[illegible]

DETAIL A
COLOR CODE



QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
					LIST OF MATERIALS OR PARTS LIST	

	5600	REF
NEXT ASSY	USED ON	NEXT ASSY/FINAL ASSY
APPLICATION		QTY REQD

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA—SUB-ASSY MRA—MAJOR REPL ASSY
MA—MODULE ASSY CA—COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'

MATERIAL: SEE L/M

APPLIED FINISH

DRAWN: L. Doraetti 7/12/65
CHECK: B.M. Kelley
ENGR:
APPR:
APPROVED
APPROVED
DR# 145

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD ASSY PREAMP ACCESSORY

CODE IDENT NO. —— | SIZE D | 400262 | D
SCALE 2 : 1 | WEIGHT —— | SHEET 5 OF 6

400262

NOTES
1. ITEM NO. 74 IS 3.9± .1% IN LENGTH

586-00 LIETZ 1000 TOPFLIGHT 4-64

INSTRUCTIONS

FOR

OHMS CONVERTER

MODEL 02

INTRODUCTION

The Dana Model 02 Ohms Converter is a signal conditioning plug-in circuit card for use with Dana Series 5600 Digital Voltmeters (DVM's). When installed in a DVM which is properly wired, it allows resistance (in kilohms) to be measured with 4 leads. The 02 is contained within and derives its power supply voltages from the DVM.

SPECIFICATIONS
Model 02 - Ohms Converter

Function	Converts DC resistance into proportional DC voltage, which is measured by DVM. Specifications refer to DVM output as a function of input resistance
Maximum Resistance	999.99 Kilohms, Series 5600
Resolution	0.01 ohm, Series 5600
Full Scale Ranges	.99999, 9.9999, 99.999, 999.99 kilohms
Accuracy	±0.01% of reading and ±0.001% of f.s. except 1000 kilohm range; ±0.03% of reading and ±0.001% of f.s. on 1000 kilohm range
Response time	
Step response	100 milliseconds
Response with range change	200 milliseconds
Voltage across unknown	10 volts at f.s. maximum current limited to 10 ma on 1 k range
Range Control	Automatic with manual override, selected by knob on DVM front panel
Decimal Point	Automatic in kilohms; ohms function selected by setting knob on DVM front panel to "kilohms"
Measuring Time	DC measuring time plus 200 milliseconds for single range; DC measuring time plus 500 milliseconds worst case with automatic range
Voltage Across Unknown	Approximately 10 volts at full scale proportionally less at less than full scale (open circuit voltage, 15 v); maximum current limited to 10 milliamperes on 1 K range.
Size and Mounting	Ohm converter is wholly enclosed in Dana Series 5600 Digital Voltmeter case; there are no additional controls or connectors

DESCRIPTION

The Model 02 Ohms Converter is an all solid state circuit card that accepts a resistance input and converts it to a DC voltage which is measured by the DVM. When used in a Dana Series 5600, highly precise resistance measuring capability is provided with automatic range selection.

The converter is essentially an operational amplifier. A precise range resistor determines the input current to the summing junction of the amplifier and the unknown resistor is the feedback resistor. One pair of leads to the unknown provides a current path while a second pair of leads senses the voltage across the unknown with negligible current flow.

Output voltage of the converter equals $V_{in} \frac{Rx}{Rr}$ where R_x = Unknown resistor

R_r = Precise range resistor

V_{in} is applied internally to the reference input of the DVM so that the DVM readout is completely determined by the ratio $\frac{Rx}{Rr}$. The value of R_r is determined by the range switch, which also positions the decimal point on the readout.

Protective features virtually eliminate the possibility of damage to the converter by inadvertent misuse. If the DVM function switch is not in "kilohms", the input is protected by a diode limiter and the output is protected by a replaceable fuse.

OPERATION

General

A Dana Digital Voltmeter equipped with the Dana Model 02 Ohms Converter makes high accuracy digital resistance measurements possible.

The Model 02 Converter utilizes a four-terminal method of measurement, allowing the lead and contact resistances to be largely balanced out.

The input cable to the instrument consists of six different leads and it is IMPORTANT that the user understand the functions of each lead and connect them properly.

OHMMETER LEAD FUNCTIONS

Current +	Delivers current (limited to 10 ma maximum at 1K)
Current -	Accepts current
Sense +	Senses Voltage
Sense -	Senses Voltage
Guard	Is connected to the floating shield (if any) of device being measured. Do not connect to unknown or ground.
Ext. Ref. 11V Max	Is not used in resistance measurements.

HOOK UP PROCEDURE (see Figures 1, 2, and 3)

1. Connect "Sense +" lead (Large Red Clip) to side of unknown nearest ground.

2. Connect "Current +" lead (Small Red Hood) to same side of unknown, outside "Sense +" lead.

3. Connect "Sense -" lead (large black clip) to opposite side of unknown.

4. Connect "Current -" lead (small black hood) to same side as "Sense -", outside "Sense -".

5. Connect "Guard" lead (small black hood) to floating shield around unknown, if shielded. Do not connect to Unknown. Do not use if unknown doesn't have floating shield.

6. DO NOT USE "Ext. Ref." lead (small white hood).

7. Switch DVM Function Switch to "kilohms".

8. If reading is noisy, shunt Unknown Resistor with a .01 mfd Polystyrene or high quality Mylar capacitor. (A .01 mfd capacitor connected internally should filter noise in most applications without additional filtering).

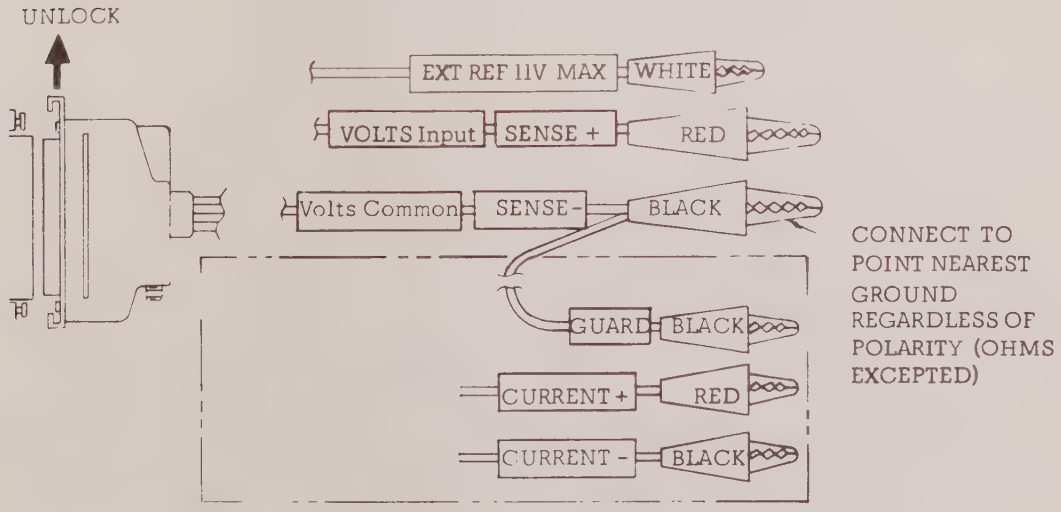


FIGURE 1 - DVM Input Cable

CAUTION

In precision resistance measurements, especially in the high resistance area, the effect of surface resistance, humidity and external noise can cause errors. It is recommended that the user employ extreme caution including proper shield and guarding, if possible, to prevent this type of error.

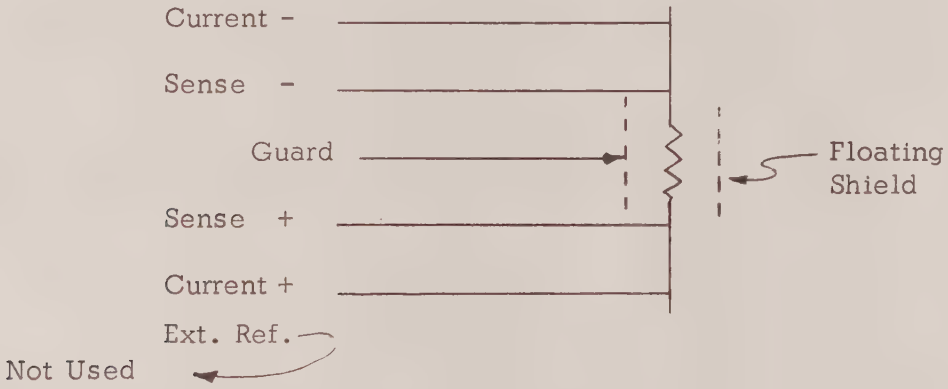


FIGURE 2 - Measurement of Floating Resistor

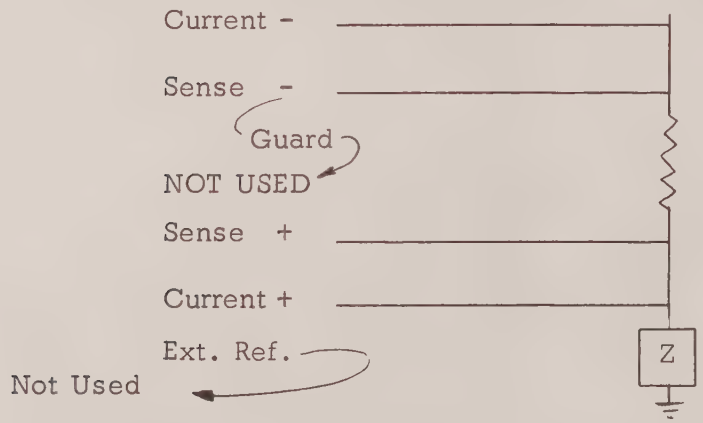


FIGURE 3 - Measurement of Resistor Tied to Ground

CALIBRATION PROCEDURE

When shipped from the factory, the Model 02 is carefully calibrated well within specifications. Calibration adjustments in the field should not be required for a least 6 months (unless input cable is changed). Calibration should not be attempted unless accurate standards are available to verify the need for calibration and to make the calibration itself.

This procedure describes two techniques for the calibration of the Ohms to DC Converter. Either procedure will provide quantitative information and data for its certification to the Manufacturers specifications. It is recommended that the Standards Laboratory technique of calibration be used periodically since this will establish a "confidence level" over a long period of time.

FIELD CALIBRATION: (See Figures 2 and 4)

Equipment Required:

* 1 - 1 Megohm Resistor, known or certified to better than ± 0.01%.
* 1 - 100,000. ohm resistor, known or certified to better than ± 0.01%.
* 1 - 10,000. ohm resistor, known or certified to better than ±0.01%.
* 1 - 1,000. ohm resistor, known or certified to better than ±0.01%.

*It is necessary that the certified value of the above resistor be slightly less than the exact values indicated above. This will permit the 5 digit DVM to be calibrated on each of the various ranges without overranging. For instance, a 999.95 ohm resistor could be read on the 1 K range of the 5 digit DVM, while a 1000.5 ohm resistor would have to be measured on the 10 K range. If the proper values are not available, series/parallel combinations of standard resistors may be used. Select combinations that will permit the various ranges to be calibrated near full scale. The temperature coefficient in parts per million per degree centigrade should be known. This is especially important where wide temperature gradients exist. Corrections in ppm/per degree centigrade should be applied where such conditions exist.

1.0 Turn on the DVM and allow at least one-half hour warm-up time.

1.1 Select the 100K standard resistor and connect as shown in Figure 2. (Pg. 4.3)

Note: The black "Sense-" and the black "Current-" leads are connected to one end of the resistor and the red "Current +" and the red "Sense +" leads are connected to the other end of the resistor. It is usually necessary to shield the 100K resistor, in which case the guard would be connected to the shield.

1.2 Set the mode switch to the Periodic position.

1.3 Set the function switch to the Ohms position.

1.4 Set the range switch to the 100K position.

1.5 Adjust the 100K calibration potentiometer on the Ohms Converter card, (third trimpot from bottom) to agree with the certified value of the standard resistor. (See Figure 4.)

1.6 Next install the 1 megohm standard resistor in place of the 100K standard, set the range switch to the 1,000K position, and adjust the 1 megohm calibration potentiometer on the Ohms Converter card, (fourth trimpot from bottom) to agree with the certified value of the standard resistor.

1.7 Next install the 10,000 ohm standard resistor in place of the 1 megohm standard, set the range switch to the 10K position, and adjust the 10K calibration potentiometer on the Ohms Converter card, (second trimpot from bottom) to agree with the certified value of the standard resistor.

1.8 Next install the 1,000 ohm standard resistor in place of the 10,000 ohm standard, set the range switch to the 1K position, and adjust the 1K calibration potentiometer on the Ohms Converter card, (bottom trimpot) to agree with the certified value of the standard resistor.

Notes: Since there is some interaction between the various calibration adjustments, it is important that the ranges be calibrated in the order shown. Do not attempt to adjust either the "Voltage Zero" or "Current Zero" trimpots in the field. These adjustments must be made with a Null Galvanometer and are best done in the Standards Laboratory.

This completes the Field Calibration Procedure.

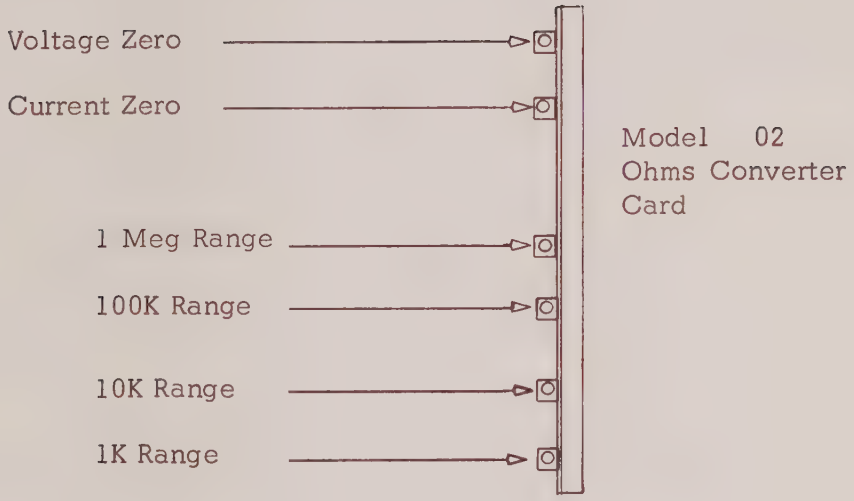


FIGURE 4 - Ohms Converter Adjustments

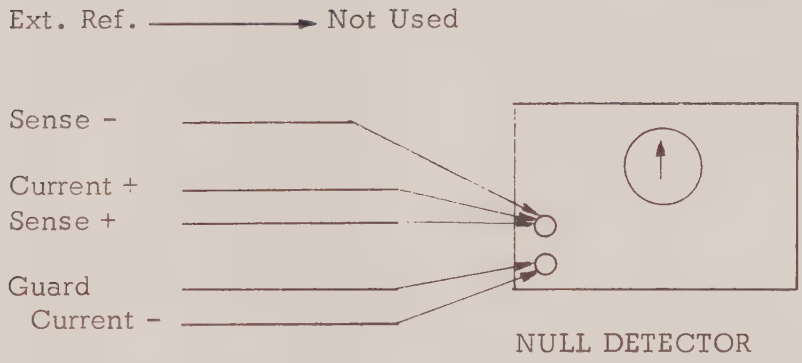


FIGURE 5. Standards Laboratory Adjustment of Voltage Zero

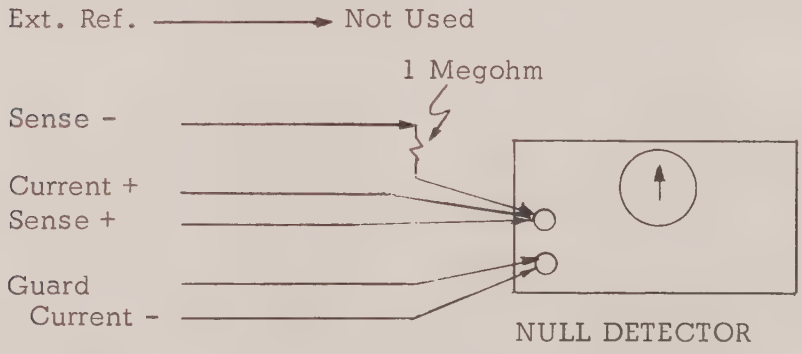


FIGURE 6. Standards Laboratory Adjustment of Current Zero

STANDARDS LABORATORY CALIBRATION PROCEDURE: (See Figures 4, 5, and 6)

The technique for Standards Laboratory calibration of the Dana 02 Ohms to DC Converter is that used by the factory. It is designed to provide the user with the highest accuracy possible using Laboratory standards.

Equipment Required:

1 - 1,000,000.0 ohm standard resistor, known or certified to ±0.005% or better with T/C of 10 ppm or less. L & N 4020 NBS series.

1 - 100,000.0 ohm standard resistor, known or certified to ±0.005% or better with T/C of 10 ppm or less. L & N 4020 NBS series.

1 - 10,000.0 ohm standard resistor, known or certified to ±0.005% or better with T/C of 10 ppm or less. L & N 4020 NBS series.

1 - 1,000.0 ohm standard resistor, known or certified to ±0.005% or better with T/C of 10 ppm or less. L & N 4020 NBS series.

1 - Guarded DC electronic null detector. L & N Model 9834 or equivalent.

2.0 In standards laboratories equipped for close temperature control, it is recommended that the DVM be "temperature soaked" in an operating condition for at least two hours prior to calibration.

2.1 Connect the null detector as shown in Figure 5. ("Guard" is galvo common, red "Sense +" / "Volts Input" lead is galvo + input). Set the DVM on the 1,000K range.

2.2 Short the red "Sense +", red " Current +", and black "Sense -" leads together. Connect the "Current -" and the Guard to galvo common. The "Ext Ref" lead is left unconnected.

2.3 Zero or null the DVM as indicated on the null detector by adjusting the Voltage Zero (top trimpot) on the Ohms to DC Converter card. This zero or null should be less than 20 microvolts.

2.4 Next, connect the 1 megohm standard resistor as shown in Figure 6. The "Ext Ref" 11V Max lead is left unconnected.

2.5 Zero or null the DVM as indicated on the Null Detector by adjusting the Current Zero (second trimpot from the top) on the Ohms to DC Converter card. This zero or null can be adjusted to approximately 25 microvolts or less (noise level of this approximate level is normal).

2.6 Use the 100K ohm standard resistor and set the controls as follows:

Mode switch to the "Periodic" position.
Function switch to the "Ohms" position.
Range switch to the 100K position.
Threshold potentiometer to full clockwise position.
Connect the black "Sense-" lead to one potential terminal on the NBS standard resistor. Connect the black "Current-" lead to the adjacent current terminal on the NBS standard resistor.
Connect the red "Current +" lead to the other current terminal on the NBS standard resistor.
Connect the red "Sense +" lead to the other potential terminal on the NBS standard resistor.
It is usually necessary to place the test resistor in a floating shield in which case, the Guard will be connected to the shield. The "Ext Ref" lead is not used.

2.7 Adjust the 100K calibration potentiometer on the Ohms to DC Converter card (third trimpot from bottom) to agree with the certified value of the standard resistor.

2.8 Replace the 100K standard resistor with the 1 megohm standard, set the range switch to the 1,000K position, and adjust the 1 megohm calibration potentiometer on the Ohms to DC Converter card (fourth trimpot from bottom) to agree with the certified value of the standard resistor.

2.9 Replace the 1 megohm standard resistor with the 10,000. ohm standard, set the range switch to the 10K position, and adjust the 10K calibration potentiometer on the Ohms to DC Converter card (second trimpot from bottom) to agree with the certified value of the standard resistor.

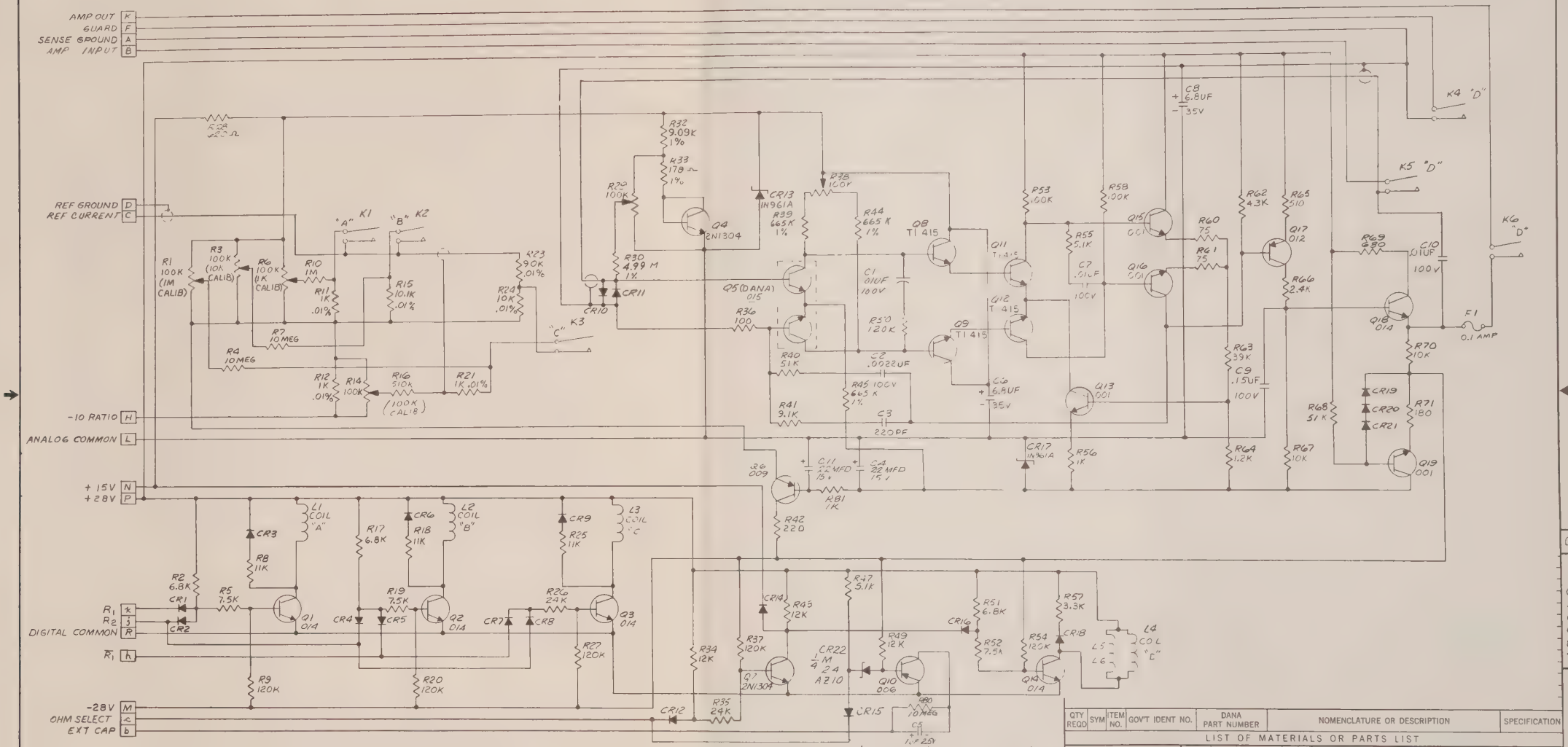
3.0 Replace the 10,000. ohm standard resistor with the 1,000. ohm standard, set the range switch to 1K position, and adjust the 1K calibration potentiometer on the Ohms to DC Converter card (bottom trimpot) to agree with the certified value of the standard resistor.

3.1 This completes the calibration. If desired and required, intermediate values of resistances by means of series/parallel combinations of standard resistors may be measured and recorded.

Note: Since there is some interaction between the various calibration adjustments, it is important that the ranges be calibrated in the order shown.

OHMS CONVERTER SPARE
SPARE PARTS LIST
Less 5% Carbon Resistors

PART NO.	DESCRIPTION	QTY	REC'D SPARES	APPROX. PRICE Ea.
RESISTORS				
010039	9.09K, RN60D, Metal Film	1	1	.60
010040	178 ohm, RN60B, Metal Film	1	1	.60
010102	665K, RN65C, Metal Film	3	1	3.00
020033	Set - .01%, 5PPM, Wirewound, ESI TS-10 Process or EQUIV, 1 ea 10K,10.1K,90K, 2 ea 1K (5 Pcs)	1 set	1 set	65.00
011178	4.99 Meg., 1%, Carbon Film	1	1	.55
021395	1.0K, 5 PPM, Wirewound	1	1	8.00
040004	Potentiometer - 100K, E-Z Trim	6	1	4.00
CAPACITORS				
101175	220 pf, 10% Ceramic Disc	1	1	.15
110001	6.8uf, 35V, Tantalum	2	1	2.40
110006	100uf, 10V, Tantalum	1	1	3.75
111095	1uf, 25V, Electrolytic	1	1	.80
121088	.01uf, 100V, Mylar	3	1	.30
121092	.0022uf, 100V, Mylar	1	1	.25
121394	.15uf, 100V, Mylar	1	1	.60
200001	Transistor - Type 008 (Dana)	1	1	8.50
200006	Transistor - 2N2716(SS)Special Selected	4	1	1.75
200015	Transistor - Type 011	1	1	15.00
200025	Transistor - Dual, Specially Selected	1	1	SS
201084	Transistor - Type 2N1304, T. I.	2	1	1.00
201085	Transistor - Type 005 (Dana), T. I.	5	1	1.60
201109	Transistor - Type 001 (Dana, T. I.	4	1	3.50
201143	Transistor - Type 488, T. I.	1	1	6.50
211083	Diode - IN662	19	2	.50
221177	Diode - Zener, 1/4M2.4AZ10, 2.4V	1	1	2.25
221254	Diode - Zener, IN961A	2	1	7.50
310003	Relay - 24V, #MRR1A, Dunco	4	1	12.00
310004	Relay - 24V, #MRR2A, Dunco	1	1	30.00



NOTES: UNLESS OTHERWISE NOTED.
1. ALL DIODES IN662
2. ALL RESISTORS 1/4 W 5%.

QTY REQD	SYM	ITEM NO.	GOVT IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'

MATERIAL: NONE

APPLIED FINISH: NONE

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY

APPLICATION | QTY REQD

SYMBOLS APPLICABLE TO DANA LABORATORIES INC. ONLY
SA.—SUB-ASSY MRA.—MAJOR REPL ASSY
MA.—MODULE ASSY CA.—COMPLETE ASSY

DRAWN D. HARRIS 21 JUNE 1963
CHECK
ENGR
APPR
APPROVED
APPROVED

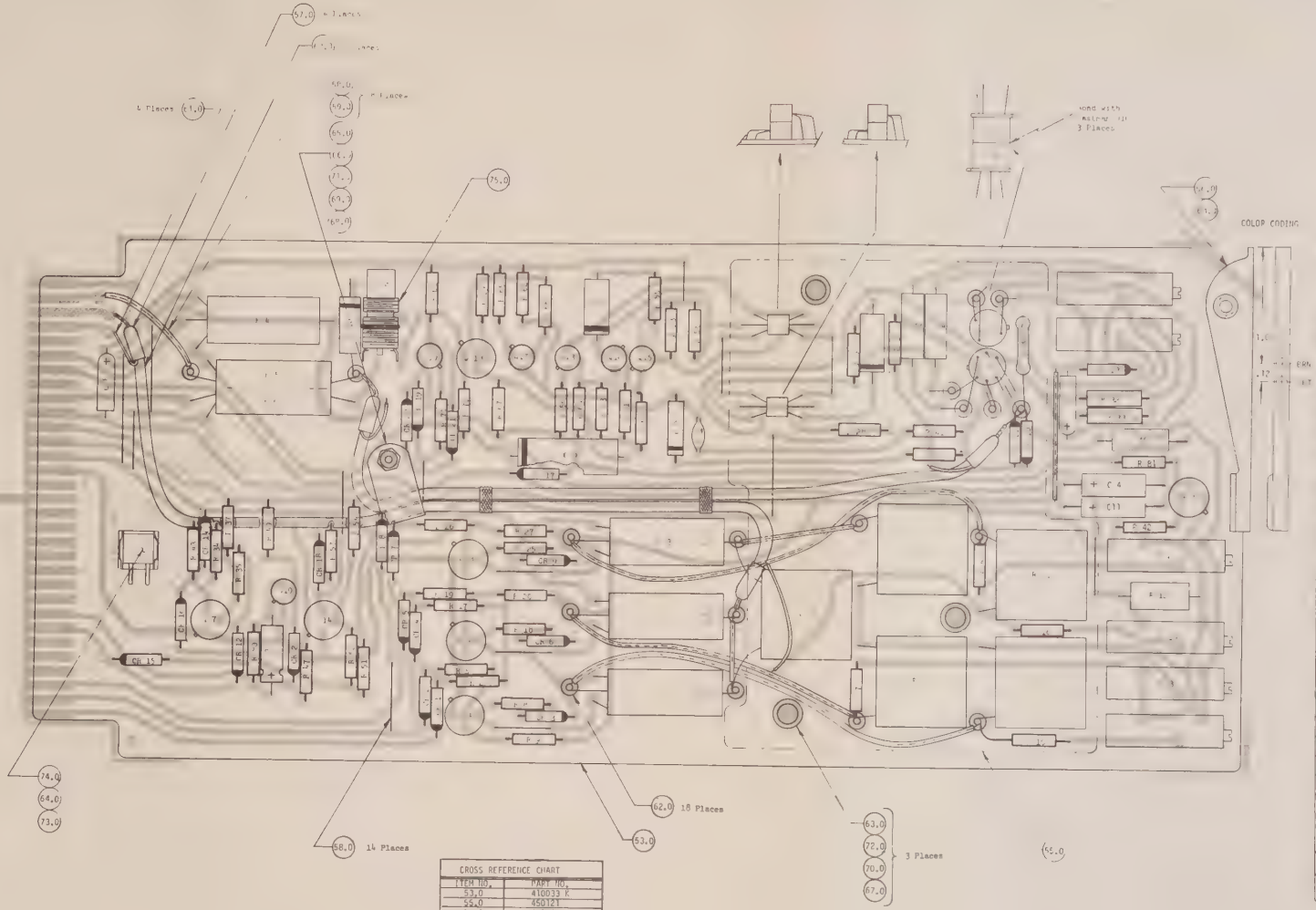
DANA LABORATORIES INC.
SANTA ANA, CALIF.

SCHEMATIC - OHMS TO DC CONVERTER

CODE IDENT NO —
SIZE D
430050 - P
SCALE NONE
WEIGHT —
SHEET 1 OF 1

430050 P

LIETZ 1118 TOPPLIGHT 10-62



REF DES	B/M ITEM	DESCRIPTION
F		.1 Amp Fuse
CR2	1.0	1/4W2.4AZ10
CR4	5.0	IN662
CR5	6.0	IN662
CR6	19.0	IN662
CR16	49.0	IN662
CR17	50.0	IN961A
CR11	35.0	IN662
CR15	34.0	IN662
CR14	44.0	IN662
CR13	54.0	IN961A
CR12	49.0	IN662
THRU		
CR 1	45.0	IN662
C 11	37.3	22 MFD/15V
C 10	40.0	.01 MFD/100V
C 9	41.5	.15 MFD/100V
C 8	37.0	6.8 MFD/35V
C 7	40.0	.01 MFD/100V
C 6	37.0	6.8 MFD/35V
C 5	37.3	1 MFD/25V
C 4	37.3	22 MFD/15V
C 3	38.0	220 pf
C 2	41.0	.0022MFD/100V
C 1	40.0	.01 MFD/100V

REF DES	B/M ITEM	DESCRIPTION
R 1	35.0	100 K (POT)
R 2	26.0	6.8 K
R 1	35.0	100 K (POT)
R 19	47.0	001
R 18	43.8	014
R 17	42	012
R 16	47.0	001
R 15	47.0	001
R 14	43.8	014
R 13	47.0	001
R 12	42.0	T 14
R 11	42.0	T 14
R 10	47.2	006
R 9	42.0	T 14
R 8	42.0	T 14
Q 7	44.0	2N1304
R 6	43.0	009
R 5	43.9	015
Q 4	44.0	2N1304
R 3	43.8	014
R 2	43.8	014
R 1	43.8	014
K 6	52.0	Relay #MRR2A
K 5		
K 4	51.0	Relay #MRR1A
K 3	51.0	Relay #MRR1A
K 2	51.0	Relay #MRR1A
K 1	51.0	Relay #MRR1A

REF DES	B/M ITEM	DESCRIPTION
R 38	35.0	100 K (POT)
R 37	35.0	120 K
R 36	1.0	100 Ohms
R 35	14.0	24 K
R 34	5.0	12 K
R 33	32.0	178 Ohms, 1%
R 32	31.0	9.09K 1%
R 30	32.8	4.99 K 1%
R 29	35.0	100 K (POT)
R 28	24.0	620 Ohms
R 27	19.0	120 K
R 26	14.0	24K
R 25	7.0	11 K
R 24	33.0	10 K .01%
R 23	33.0	90 K .01%
R 21	33.0	1 K .01%
R 20	30.0	120 K
R 19	26.0	7.5 K
R 18	7.0	11 K
R 17	26.0	7.5 K
R 16	23.0	510 K
R 15	33.0	10.1 K .01%
R 14	35.0	100 K (POT)
R 12	34.0	1 K
R 11	33.0	1 K .01%
R 10	5.0	1 Meg
R 9	1.0	120 K
R 8	7.0	11 K
R 7	6.0	10 Meg
R 6	35.0	100 K (POT)
R 5	28.0	7.5 K
R 4	6.0	10 Meg

REF DES	B/M ITEM	DESCRIPTION
R 81	2.0	1 K
R 80	6.0	10 Meg
R 71	11.0	180 Ohms
R 70	3.0	10 K
R 69	25.0	680 Ohms
R 68	8.0	51 K
R 67	11.0	10 K
R 66	13.5	2.4 K
R 65	20.0	510 Ohms
R 64	8.0	1.2 K
R 63	18.0	39 K
R 62	18.5	4.3 K
R 61	27.0	75 Ohms
R 60	27.0	75 Ohms
R 58	4.0	100 K
R 57	17.0	3.3 K
R 56	2.0	1 K
R 55	2.0	5.1 K
R 54	10.0	120 K
R 53	4.0	100 K
R 52	28.0	7.5 K
R 51	26.0	8.8 K
R 50	10.0	120 K
R 49	9.0	12 K
R 47	21.0	5.1 K
R 45	32.5	665 K 1%
R 44	32.5	665 K 1%
R 43	9.0	12 K
R 42	13.0	220 Ohms
R 41	29.0	9.1 K
R 40	22.0	51 K
R 39	32.5	665 K 1%

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
53.0	410033 K
55.0	450121
56.0	451 K
57.0	500004
58.0	500008
59.0	501376
60.0	5?144E
61.0	524000
62.0	600030
63.0	610.19
64.0	610.50
65.0	610.53
66.0	615.44
67.0	615E07
68.0	617.04
69.00	617077
70.0	617077
71.0	617102
72.0	617103
73.0	700054
74.0	920111
75.0	920121

1. Resistors to be 1/4W, ± 5%, Carbon

NOTES: unless otherwise specified.

QTY REQD	SYM	ITEM NO	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY

APPLICATION — QTY REQD

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA — SUB—ASSY MRA — MAJOR REPL ASSY
MA — MODULE ASSY CA — COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN
CHECK
ENGR
APPR

APPROVED

APPROVED

11-1-65

DKN # 193

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASS'Y —
OHVS TO DC CONVERTER

CODE IDENT NO. —

SIZE D

400055 U

SCALE 2/1

WEIGHT —

SHEET 1 OF 1

400055 U

506-00 LIETZ 1030 TOPFLIGHT 4-64

INSTRUCTIONS

FOR

AC CONVERTERS

MODELS 20 & 25

INTRODUCTION

The Dana Model 20 and 25 AC Converters are signal conditioning plug-in circuit cards for use with Dana Series 5600, 5603 and 5640 voltmeters, (DVM's). When installed in a DVM which is properly wired, it allows AC Voltages to be measured with the normal voltmeter leads. They are contained within and derive power supply voltages from the digital voltmeter. The guarded input characteristics of the Dana DVM are retained for AC measurements. Full resolution of the DVM is available for AC measurements including the 1 volt full scale range.

SPECIFICATIONS
MODEL 20 AND 25

Function	Converts AC voltage into proportional DC voltages, which are measured by the DVM; all specifications refer to output of DVM as a function of AC voltage input
Frequency Range	
Model 20	10 cps to 20,000 cps
Model 25	10 cps to 100,000 cps
Maximum voltage	500 volts RMS, 50 cps to 10 kc, decreasing to 150 volts at 50 kc and above
Full scale ranges	.99999, 9.9999, 99.999, 999.99
Accuracy	
Model 20 (20 kc)	±0.1% of reading or ±0.02% of f.s., 50 cps to 10 kc; ±0.25% of reading or ±0.03% of f.s., 10 kc to 20 kc
Model 25 (100 kc)	±0.1% of reading or ±0.02% of f.s., 50 cps to 10 kc; ±0.25% of reading or ±0.05% of f.s., 10kc to 50 kc; ±0.5% of reading or ±0.1% of f.s., 50 kc to 100 kc
Response Time	
Step response	0.4 second to within 0.1% of final value
Response time with range change	1.6 seconds
Input characteristics	
Input resistance	1 megohm, all ranges
Shunt capacitance (exclusive of external cable)	less than 47 pf, all ranges
Calibration	RMS for sine wave input; 1.11 times full wave average magnitude for other wave forms
Dana Certification	Sine wave
Range Control	Automatic with manual override selected by knob on DVM front panel

AC Converter	
Typical Accuracy	10 - 50 cps: 1% of reading or 0.2% of full scale of range, whichever is greater
Decimal Point Indication	Automatic
Isolation	AC input is isolated and guarded from ground, the AC power line, electrical output
Size and Mounting	AC converter is enclosed entirely within Dana Series 5600 DVM (5 1/4" high EIA rack); there are no additional cables, connectors, or controls
Card Location	Address 21
Color Code	Yellow/Grey

DESCRIPTION

The Model 20/25 AC Converter is an all solid state circuit card that accepts an AC signal and converts it to a DC voltage which is measured by the DVM. When used in a Dana Series 5600, highly precise AC measuring capability is provided with automatic range selection.

The converter is essentially an AC amplifier with precise gain followed by a full wave rectifier and a low pass filter.

The converter senses the average value of the waveform and scales the output to indicate the RMS value of a sine wave.

Because the converter must present a stable and precise DC output, the output is well filtered; the time constant of the converter is a result of this filtering.

OPERATION

When the Model 20, (25), is installed in a Dana DVM, full AC measuring capability is available using the normal input leads. Basically, operation of the DVM for AC measurements is the same as for DC measurements, since the normal guarded input circuit is utilized, and all automatic features are available.

Referring to Figure 5.1 of the Basic DVM manual, the Function switch is placed in "AC Volts". The Range switch may be either on one of the manually selected ranges or in "Auto".

Some care should be taken to select the correct Mode position. For most measurements, the "Tracking" mode should be used. This allows the DVM to track any significant change in voltage with new readings as often as 5 times per second.

When the "Tracking" mode is used and a range change occurs, an internal delay allows the filter to settle to full accuracy before a new reading is taken.

Much greater stability at all frequencies, and especially lower frequencies, can be obtained by using the internal DVM Filter. The only disadvantage in this operation is a slightly longer settling time and range change.

STANDARDS LABORATORY CALIBRATION PROCEDURE FOR DANA
AC CONVERTER MODELS 20 AND 25

Equipment Required:

AC Signal source, 50 cps to 100 kc, 0-500.00 volts RMS with less than 0.03% distortion.

Dana DVM extender card assembly and converter input extender cable (supplied with an AC Calibration Kit, Part No. 400919).

GENERAL

There are nine (9) adjustments on the Model 20 and 25 Converters. One unmarked potentiometer (top of unit nearest the rear) is to adjust for zero output with the input shorted. The remaining eight (8) adjustments are to calibrate the units four ranges. Each range has potentiometer to calibrate at low frequencies and a trim capacitor for high frequency calibration. The eight calibration adjustments are clearly marked immediately adjacent to each control. It is important that calibration be performed in the following sequence.

1.0 With the DVM power OFF, insert the converter with extender card, support bracket, and extender cable into the DVM.

1.1 Turn the power on and allow the voltmeter to warm up 30 minutes.

2.0 Zero Adjustment

2.1 Place the Function switch to AC volts, "Range" to 100, and "Mode" to PERIODIC.

2.2 Set DVM to its 100 volt range and short the input. Adjust the zero potentiometer clockwise until an offset is observed. Reverse the adjustment to the point of zero display.

NOTE: After each range is calibrated, it should be checked for proper response. Suggested points are:

Model 20 - $\pm$0.1% at 50 cps, 400 cps, 1 kc, 5 kc, and 10 kc or $\pm$0.02% of full scale; $\pm$0.25 at 20k or $\pm$0.03% of full scale.

Model 25 - $\pm$0.1% at 50 cps, 400 cps, 1 kc, 5 kc, and 10 kc or $\pm$0.02% of full scale; $\pm$0.25% at 25 kc and 50 kc or $\pm$0.05% of full scale; $\pm$0.5% at 100 kc or $\pm$0.1% of full scale.

3.0 1000 volt range - Set the DVM to its 1000 v range, mode switch to periodic and function selector to AC volts. Set the AC source to 500 volts at 400 cps and adjust the 1000 volt potentiometer for minimum error. Set the AC source to 125 volts at *50 kc and adjust the 1000 v trim capacitor for minimum error. Repeat these two steps as required, being careful to check the *50 kc calibration last.

4.0 100 volt range - Set the DVM to the 100 v range, periodic, and AC volts. Set the AC source to 99 volts at 400 cps and adjust the 100 volt potentiometer for minimum error. Set the AC source to 99 volts at *50 kc and adjust the 100 volt trim capacitor for minimum error. Repeat these two steps as required, checking calibration at *50 kc last.

5.0 1 volt range - Set the DVM to the 1 v range, periodic, and AC volts. Set the AC source to .99 volts at 400 cps and adjust the 1 volt potentiometer for minimum error. Set the AC source to .99 volts at *50 kc and adjust the 1 volt trim capacitor for minimum error. Repeat these two steps as required, checking calibration at *50 kc last.

6.0 10 volt range - Set the DVM to the 10 v range, periodic and AC volts. Set the AC source to 9.9 volts at 400 cps and adjust the 10 volt potentiometer for minimum error. Set the AC source to 9.9 volts at *50 kc and adjust the 10 volt trim capacitor for minimum error. Repeat these two steps as required, checking calibration at *50 kc last.

7.0 Final Check - Remove the converter from the extender card and install it in its operational position. Check the accuracy of each range at several frequencies over the range of 50 cps to *50 kc. If any single range requires adjustment, recheck lower ranges sequentially beginning with the highest applicable range. As each range is readjusted, check calibration at *50 kc last.

8.0 Sequence of Adjustments - After the details of calibration are learned, the summary shown below will serve to expedite calibration.

Range	Test Voltage	Test Frequency	Adjustment
100 volt	Shorted input	-	Zero Potentiometer for zero display
1000 volt	500 volts	400 cps	1000 v potentiometer
1000 volt	125 volts	*50 kc	1000 trim capacitor
100 volt	99 volts	400 cps	100 v potentiometer
100 volt	99 volts	*50 kc	100 v trim capacitor
1 volt	.99 volts	400 cps	1 v potentiometer
1 volt	.99 volts	*50 kc	1 v trim capacitor
10 volt	9.9 volts	400 cps	10 v potentiometer
10 volt	9.9 volts	*50 kc	10 v trim capacitor

* For Model 25 AC Converter only - Use 10 kc source for Model 20.

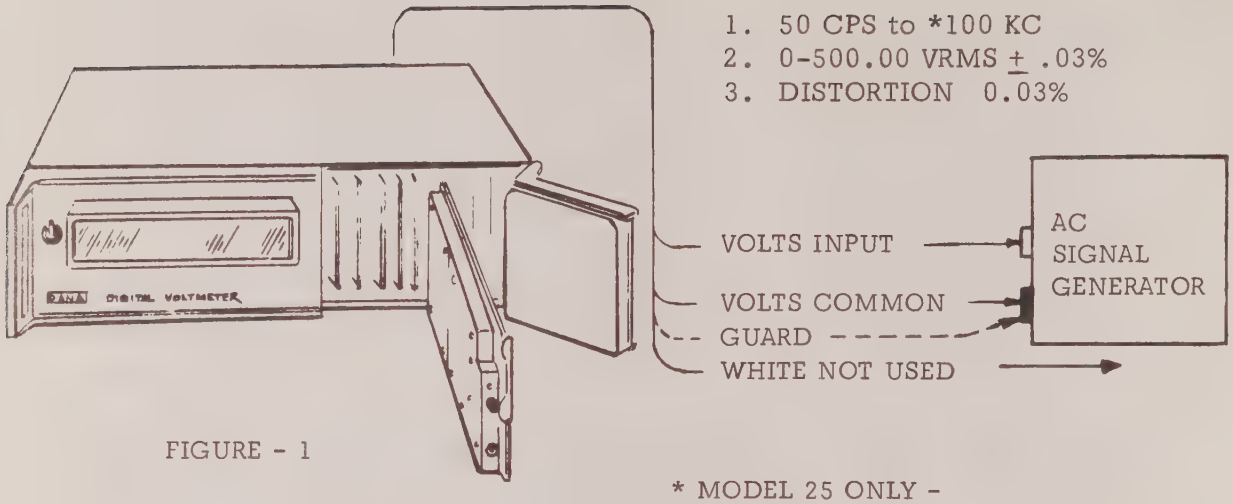
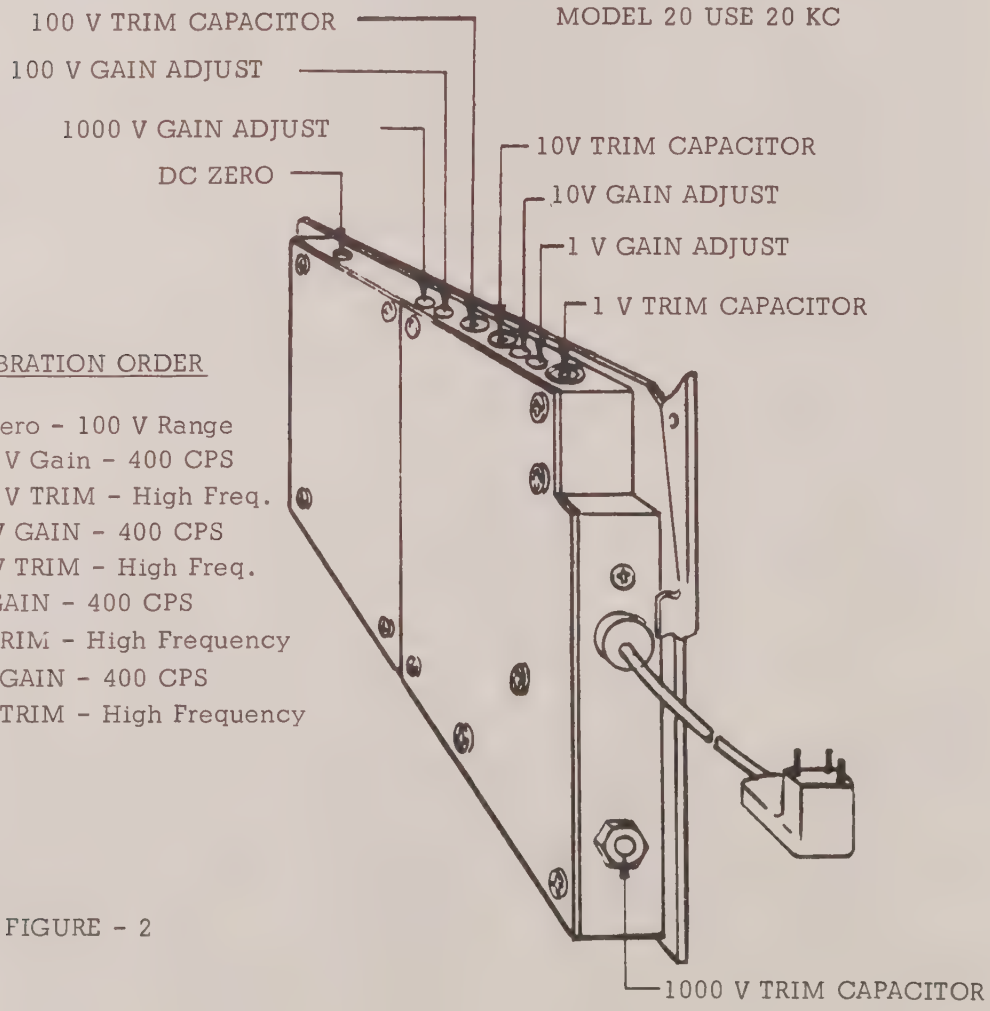


FIGURE - 1

* MODEL 25 ONLY -
MODEL 20 USE 20 KC



CALIBRATION ORDER

1 - DC Zero - 100 V Range
2 - 1000 V Gain - 400 CPS
3 - 1000 V TRIM - High Freq.
4 - 100 V GAIN - 400 CPS
5 - 100 V TRIM - High Freq.
6 - 1 V GAIN - 400 CPS
7 - 1 V TRIM - High Frequency
8 - 10 V GAIN - 400 CPS
9 - 10 V TRIM - High Frequency

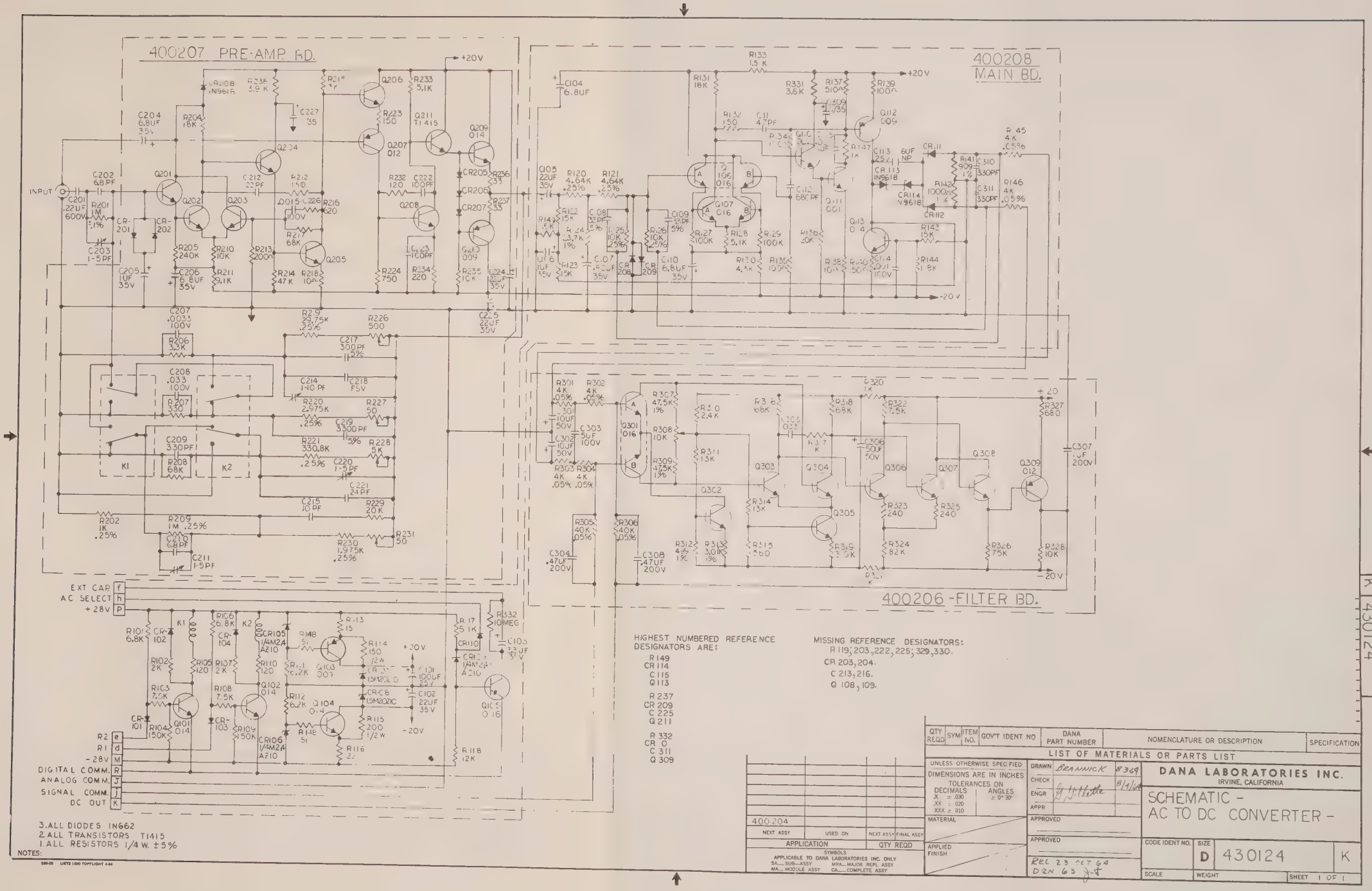
FIGURE - 2

AC CONVERTER SPARE PARTS LIST
MODEL 20 & 25
Less 5% Carbon Resistors

PART NO.	DESCRIPTION	QTY	REC'D SPARES	APPROX. PRICE
RESISTORS				
010027	499 ohms, RN60B, Metal Film	1	1	.60
010069	22.6K, 1%, RN60B, Metal Film	1	1	.60
010140	4.64K, ±.25%, RN60C, Metal Film	2	1	3.95
010141	10K, RN60C, ±.25%, Metal Film	2	1	3.95
010142	909 ohm, 1%, RN60B, Metal Film	1	1	2.55
010148	1 Meg., .1%, RN75C, Metal Film	1	1	4.70
010150	29.75K, .25%, RN60C, Metal Film	1	1	3.00
010151	Resistor - 2.975K, .25%, RN60C, Metal Film	1	1	3.00
010152	330.8K, .25%, RN60C, Metal Film	1	1	3.00
010153	1.955K, .25%, RN60C, Metal Film	1	1	3.00
010154	1 Meg, .25%, RN65C, Metal Film	1	1	3.00
010155	1K, .25%, RN60C, Metal Film	1	1	3.00
011332	1K, 1%, RN60B, Metal Film	1	1	1.15
011408	3.01K, Deposted Carbon	1	1	.70
020037	40K, .05%, Wirewound	2	1	4.50
020038	4K, .05%, Wirewound	6	1	3.50
021244	47.5K, .1%, Wirewound	2	1	3.50
POTENTIOMETERS				
040005	10K, Bourns #3067P-1-1-3	1	1	4.50
040012	50 ohm, Techno Model 40	1	1	10.50
040027	5K, Techno Model 40	1	1	10.50
CAPACITORS				
100005	22pf, Ceramic Disc	1	1	2.00
101098	330pf, 10%, Ceramic Disc	3	3	.15
101099	680pf, Ceramic Disc	1	1	.15
101145	100pf, Ceramic Disc	2	1	.15
101182	47pf, Ceramic Disc	1	1	.20
110001	6.8uf, 35V, Tantalum	2	1	2.40
110002	22uf, 35V, Tantalum	4	1	3.80
110005	10uf, 50V, Tantalum, Semcor, TSW1K-50-106	1	1	5.00
110007	6uf, 25V, Tantalum	1	1	8.00
110017	1uf, 35V, Tantalum	5	1	1.60
110019	0.82uf, 35V, 5%, Tantalum	1	1	1.90
110022	3.3uf, 35V, 10%, Tantalum	1	1	1.65
111097	50uf, 50V, Electrolytic	1	1	1.25
111148	100uf, 25V, Electrolytic	1	1	.90
120001	.0033uf, 100V, Mylar	1	1	.30
120005	.001uf, 100V, Mylar	1	1	.45
120007	.22uf, 600V, Mylar	1	1	3.75

AC CONVERTER PARTS LIST

PART NO.	DESCRIPTION	QTY	REC'D SPARES	APPROX. PRICE Ea.
CAPACITORS				
120010	.47uf, 200v, Electrocube (Matched Pair)	1	1	16.50
120012	1.0uf, 200V, Mylar	1	1	3.50
120016	5uf, 100V, 10%, Mylar	1	1	9.00
120035	33pf, 5%, Polystyrene	2	1	.45
120036	3300pf, Polystyrene	1	1	.65
120037	300pf, Polystyrene	1	1	.45
120038	27pf, Polystyrene	1	1	.45
120039	24 pf, Polystyrene	1	1	.45
121091	.033uf, 100V, Mylar	2	1	.25
121473	.0015uf, 100V, Mylar	1	1	.25
130029	1-5pf, Trimmer, Corning #682116	3	1	10.90
130030	1-10pf, Trimmer, Corning #68117	1	1	10.50
130031	8.2pf, 10%, Glass	2	1	6.75
TRANSISTORS				
200005	TI-415	19	2	1.75
200011	Type 009	3	1	10.00
200017	Type 001	2	1	3.50
200022	Type 012	3	1	4.50
201176	SS71032B	1	1	81.00
211083	Diode - IN662	15	4	.50
220013	Diode - Zener, IN3796	2	1	
221177	Diode - Zener, 1/4M2.4AZ10	3	1	2.25
221254	Diode - Zener, IN961A	2	1	7.50
310011	Relay - Babcock #BR-16	2	1	42.00
600082	Connector - 4-Pin, Winchester #JF-2P-2P	1	1	1.98
600083	Connector - 4-Socket, Winchester #JF-2S-2S	1	1	2.40
459348	Plate-Cover (Model 20)	1	0	
450551	Plate - Cover (Model 25)	1	0	



HIGHEST NUMBERED REFERENCE DESIGNATORS ARE:

R 149
CR 114
C 115
Q 113

R 237
CR 209
C 225
Q 211

R 332
CR 0
C 311
Q 309

MISSING REFERENCE DESIGNATORS:
R 119; 203, 222, 225; 329, 330.
CR 203, 204.
C 213, 216.
Q 108, 109.

NOTES:
1. ALL RESISTORS 1/4 W. ±5%
2. ALL TRANSISTORS T1415
3. ALL DIODES IN662

400204

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA — SUB-ASSY MRA — MAJOR REPL ASSY
MA — MODULE ASSY CA — COMPLETE ASSY

QTY REQD	SYM	ITEM NO.	GOVT IDENT NO	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'
MATERIAL
APPLIED FINISH

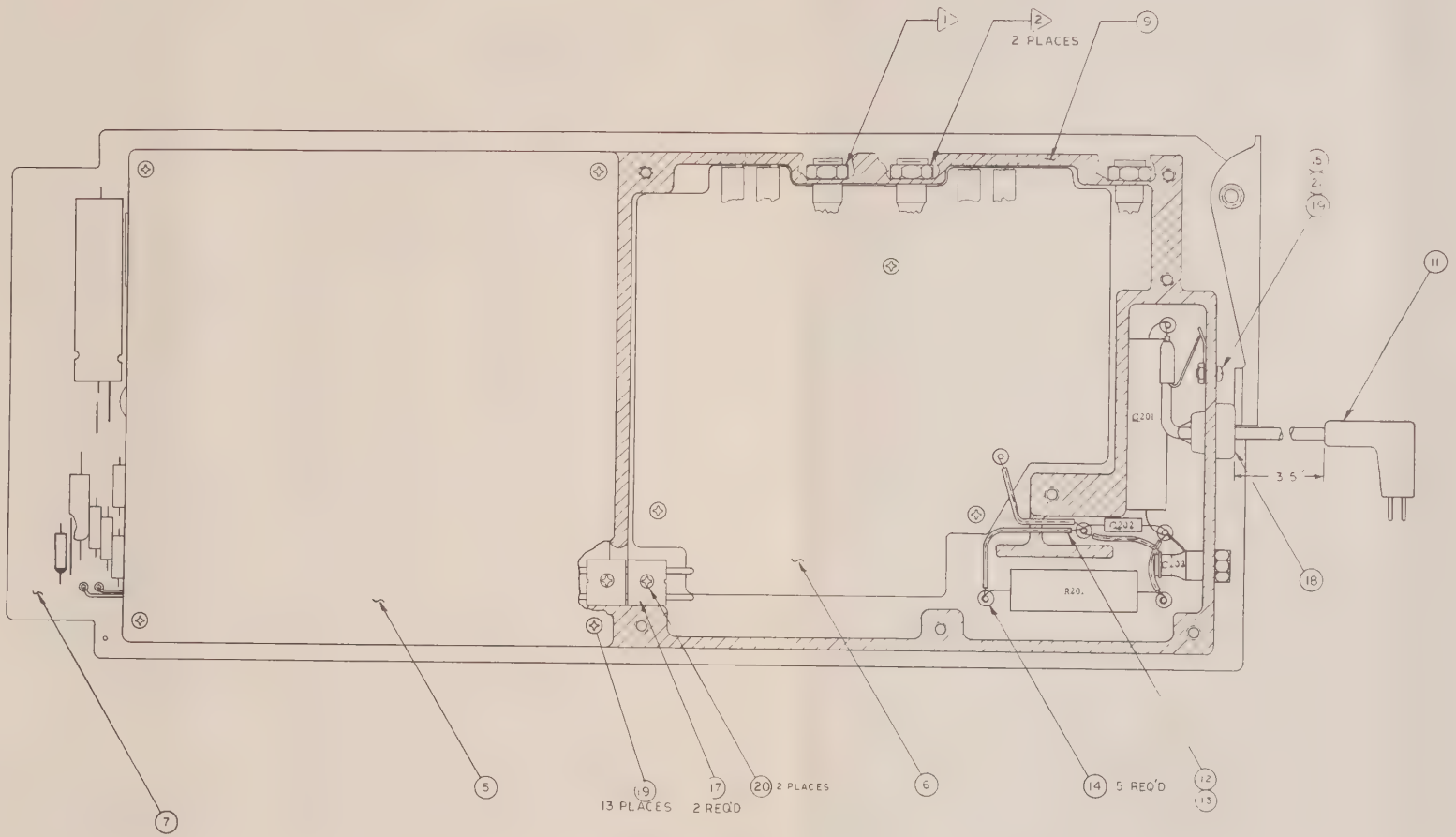
DRAWN BRANNICK 8 3 64
CHECK
ENGR
APPR
APPROVED
APPROVED
REL 23 OCT 64
DRN 63

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC –
AC TO DC CONVERTER –

CODE IDENT NO. | SIZE D | 430124 | K
SCALE | WEIGHT | SHEET 1 OF 1

K 430124



REF DES	B/M ITEM	DESCRIPTION
R201	.	. Meg 1%RN75C
C203	3	[illegible]
C202	4a	6.8pf .1% [illegible]
C201	.	.22MFD 600V

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
5	400206
6	400207
7	400208
9	450307
11	450390
12	500004
13	501326
14	600030
15	600032
17	600083
18	610143
19	615042
20	615269
21	617004
22	920026

2 SEE ITEM 46 P/N 130029 ON DRAWING NO. 400207
1 SEE ITEM 47 P/N 130030 ON DRAWING NO. 400207

NOTES:

QTY REQD	SYM	ITEM NO	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
400384						
400383						

LIST OF MATERIALS OR PARTS LIST

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA — SUB-ASSY MRA — MAJOR REPL ASSY
MA — MODULE ASSY CA — COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'

MATERIAL: SEE B/M

APPLIED FINISH

DRAWN	W. Edie	6 May 1965
CHECK	B Talley	6-6-65
ENGR	L. Whittle	7-13-65
APPR		

APPROVED

APPROVED: Lee 7-13-65

DEN # 149

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

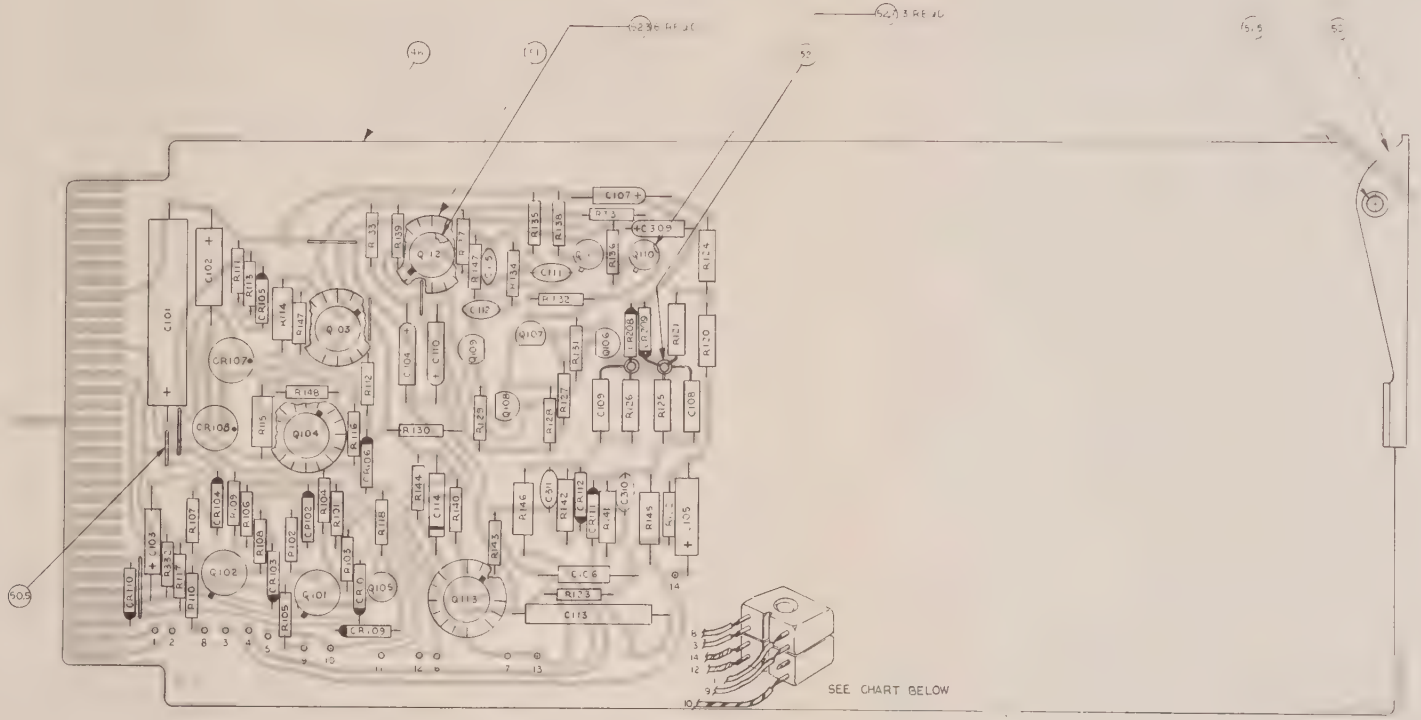
AC/DC CONVERTER ASS'Y

CODE IDENT NO.	SIZE	
	D	400204 H

SCALE 2/1 | WEIGHT | SHEET 1 OF 1

H 400204

686-00 LIETZ 1080 TOPFLIGHT 1-64



REF DES	ITEM	VALUE
C101	35	100 UF 25 V
R [illegible]	35	10 MEG
R [illegible]	45	3.6 K
R 46	27	4K .05% WW
R 45	29	4K .05% WW
R 44	9	1.8K
R143	7	1.5K
R 42	26	1K ½% METAL FILM
R 41	25	909 ½% METAL FILM
R 40	6	150Ω
R139		100Ω
R 38	1	10Ω
R137	16	510Ω
R136	11	20K
R135	2	1.00Ω
R134	1	100Ω
R 33	15	5K
R 31	6	150Ω
R [illegible]	15	6K
R 30	15	4.3K
R 29	3	100K
R 28	17	5.1K
R127	3	100K
R126	24	10K±25% METAL FILM
R [illegible]	24	10K±25% METAL FILM
R [illegible]	22	23.7K-1% METAL FILM
R 23	7	15K
R122	7	15K
R 21	23	4.64K .05%
R120	23	4.64K .05%
R [illegible]	5	12K
R [illegible]	20	7.5K
R [illegible]	12	22Ω
R115	21	200Ω 1/2W
R 14	21.5	150Ω 1/2W
R [illegible]	5.5	15Ω
R [illegible]	18	6.2K
R 11	18	6.2K
R 10	4	120Ω
R 09	8	150K
R107	10	2K
R106	19	6.8K
R 05	4	120Ω
R104	8	150K
R103	20	7.5K
R 02	10	2K
R 01	9	6.8K

REF DES	ITEM	VALUE
R147	25	K
[illegible]	[illegible]	[illegible]
R [illegible]	[illegible]	[illegible]
R 47	28	[illegible]
C112	42	0.4
Q112	32	309
[illegible]	40	901
Q110	40	90
Q109	38	TI 415
Q108	↓	↓
Q107	↓	↓
Q106	38	TI 415
Q105	41	0.4
Q104	41.3	0.4
Q103	39	909
Q102	41.3	0.4
Q101	41.3	0.4

REF DES	ITEM	VALUE
CR209	43	IN662
CR208	43	IN662
[illegible]	43	IN662
CR111	43	IN662
[illegible]	43	IN662
[illegible]	45	1/4M2.4AZ10
CR108	43.5	1.5M20Z10
CR107	43.5	1.5M20Z10
CR106	45	1/4M2.4AZ10
CR105	45	1/4M2.4AZ10
CR104	43	IN662
CR103	↓	↓
CR102	↓	↓
CR101	43	IN662

REF DES	ITEM	VALUE
C31	28	330 PF
C30	28	330 PF
C309	33	1 UF / 35 V
C115	29.5	.001 UF
C114	36	.001 UF/100V
C113	32	6 UF/25V
C112	29	680 PF
C111	30	47 PF
C110	30.5	6.8UF/35V
C109	37	33 PF
C108	37	33 PF
C107	34.6	1.5UF/35V
C106	33	1 UF/35 V
C105	31	22 UF/35 V
C104	30.5	6.8 UF/35V
C103	34.3	3.3UF/150 V
C102	31	22UF/35V

NO	COLOR
1	VIO
2	BLU
3	GRN
4	YEL
5	ORG
6	RED
7	BRN
8	BRN
9	YEL
10	WHT - ORG
11	RED
12	WHT - RED
13	GRN
14	WHT - BRN

7 WIRE SPECTRASTRIP BETWEEN 400206 & 400208

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
46	410078
50	451036
50.5	500004
51	600016
51.5	600019
52	600137
52.3	920006
52.7	920007
54	920010
55	920026

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE 1/4W ±5%

QTY REQD	SYM	ITEM NO	GOVT IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
					LIST OF MATERIALS OR PARTS LIST	

400204			
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA — SUB-ASSY MRA — MAJOR REPL ASSY
MA — MODULE ASSY CA — COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0 30'

MATERIAL: SEE B/M

APPLIED FINISH:

DRAWN	JOE HALLAM	11-9-64
CHECK	[illegible]	[illegible]
ENGR	[illegible]	2-24-65
APPR		

APPROVED

APPROVED

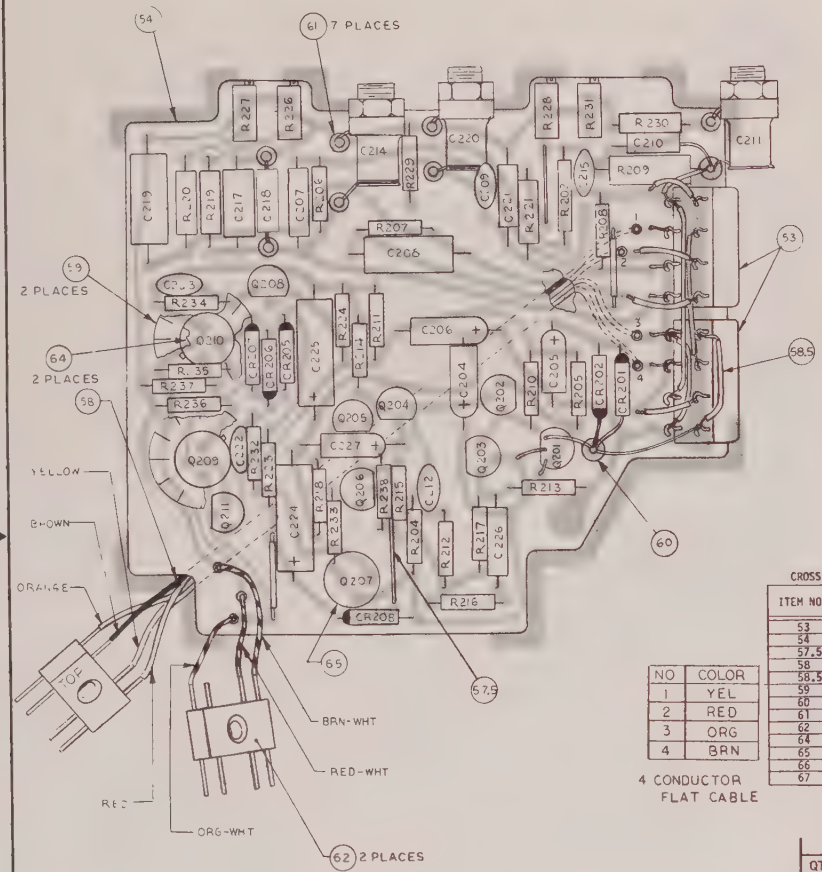
DRA # 149

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C BD ASS'Y-
AC/DC CONVERTER, MAIN

CODE IDENT NO.	SIZE		
	D	400208	D
SCALE	WEIGHT	SHEET 1 OF 1	

D | 400208



NO	COLOR
1	YEL
2	RED
3	ORG
4	BRN

4 CONDUCTOR FLAT CABLE

CROSS REFERENCE CHART

ITEM NO.	PART NO.
53	310011
54	410080
57.5	500004
58	500019
58.5	501376
59	600016
60	600030
61	600127
62	600082
64	920006
65	920007
66	920008
67	920010

REF DES	ITEM	VALUE
K1&2	53	RELAY
R237	11	33Ω
R236	11	33Ω
R235	2	10 K
R234	8	220Ω
R233	16	5.1 K
R232	3	120Ω
R231	31	50Ω POT.
R230	28.5	1.975K .25%
R229	7	20K
R228	30	5K POT
R227	31	50Ω POT.
R226	29	500Ω POT.
R224	19	750Ω
R223	4	150Ω
R221	24	330.8K .25%
R220	23	2.975K .25%
R219	22	29.75K .25%
R218	1	10Ω
R217	18	68 K
R216	17	620Ω
R215	10	3K
R214	15	47K
R213	6	200Ω
R212	4	150Ω
R211	21	9.1K
R210	2	10K
R209	26	1M .25%
R208	18	68K
R207	12	330Ω
R206	13	3.3K
R205	9	240 K
R204	5	18K
R202	27	1K .25%

REF DES	ITEM	VALUE
C227	37	1UF 35V
Q211	49	TI-415
Q210	50	009
Q209	51.3	014
Q208	49	TI-415
Q207	51	012
Q206	49	TI-415
THRU		
Q201	49	TI-415
CR208	52.5	IN961B
CR207	52	IN662
CR206	52	IN662
CR205	52	IN662
CR202	52	IN662
CR201	52	IN662
C226	45	.0015 UF 100V
C225	36	22 UF
C224	36	22 UF
C223	34	100 PF
C222	34	100 PF
C221	43	24 PF
C220	46	1-5 PF
C219	40	3300 PF
C218		F S V
C217	41	300 PF
C215	33	10 PF
C214	47	1-10 PF
C212	32	22 PF
C211	46	1-5 PF
C210	48.5	6.8 PF
C209	33	330 PF
C208	44	.033 UF
C207	38	.0033 UF
C206	35	6.8 UF
C205	37	1 UF
C204	35	6.8 UF

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
400204				1	1	
NEXT ASSY	USED ON			NEXT ASSY	FINAL ASSY	
APPLICATION				QTY REQD		

LIST OF MATERIALS OR PARTS LIST

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA—SUB—ASSY MRA—MAJOR REPL ASSY
MA—MODULE ASSY CA—COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ±.030 XX ±.020 XXX ±.010 ANGLES ±0° 30'
MATERIAL SEE B/M
APPLIED FINISH

DRAWN Joe Hallam NOV. 18. 1964
CHECK 2-1-65
ENGR 3-23-65
APPR
APPROVED
APPROVED Rel 7-13-65 DRN # 149

DANA LABORATORIES INC.
SANTA ANA, CALIF.

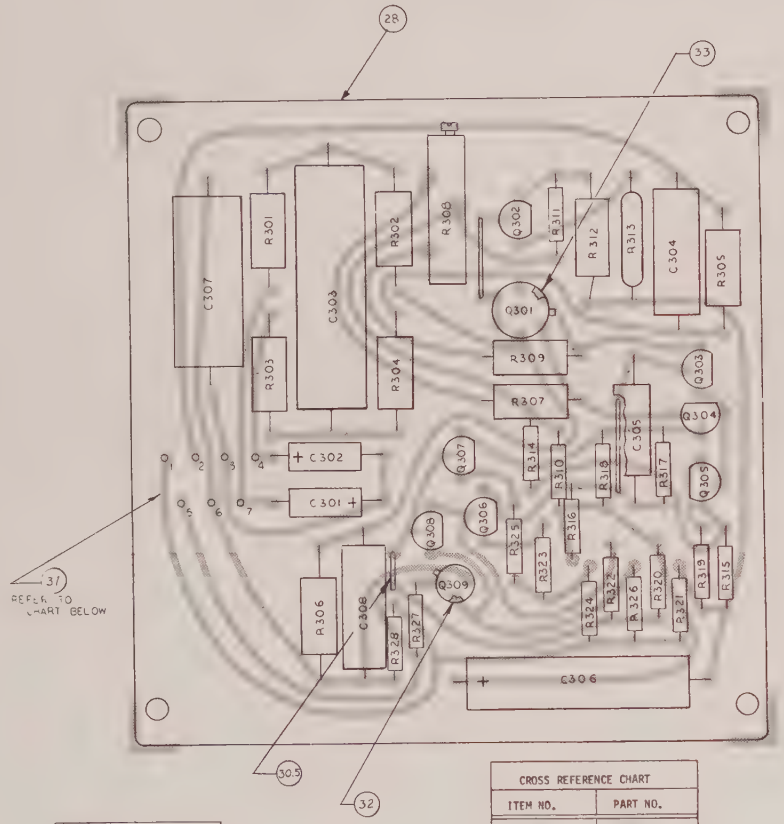
P.C. BD ASSY - PRE/AMP, AC/DC CONVERTER

CODE IDENT NO. | SIZE C | 400207 | D
SCALE 2/1 | WEIGHT | SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS 1/4W ±5%

586-00 LIETZ 1118 TOPFLIGHT 10-62

D 400207



R324	12	82 K		Q309	26	012
R323	4	240Ω		Q308	25	TI-415
R322	10	7.5K		↑ THRU ↓		↑
R321	1	1K				
R320	1	1K				
R319	6	3.9K				
R318	9	68K				
R317	1	1K				
R316	9	68K		Q302	25	TI-415
R315	7	560Ω		Q301	26.6	016
R314	3	13K				
R313	14	3.01K 1%		⚠1 C308	21	.47 UF/200 V
R312	13	499Ω 1% METAL FILM		C307	22	1 UF/200 V
R311	3	13K		C306	20	50 UF/50 V
R310	5	2.4K		C305	24	.033 UF/100 V
R309	17	47.5K WW, .1%		⚠1 C304	21	.47 UF/200 V
R308	18	10K, POT		C303	23	5 UF/100 V
R307	17	47.5K WW, 1%		C302	19	10 UF/50 V
R306	15	40K WW, .05%		C301	19	10 UF/50 V
R305	15	40K WW, .05%				
R304	16	4K WW, .05%		R328	2	10K
R303	16	4K WW, .05%		R327	8	680Ω
R302	16	4K WW, .05%		R326	11	75K
R301	16	4K WW, .05%		R325	4	240Ω
REF. DES.	B.M. ITEM	VALUE		REF. DES.	B.M. ITEM	VALUE

NO	COLOR
1	WHT - BRN - RED
2	- VIO
3	- BRN
4	- GRN
5	- ORG
6	- BLU
7	WHT - BRN - YEL

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
28	410079
30.5	500004
31	500019
32	920007
32.3	920010
32.7	920076
33	920082

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

NEXT ASSY	USED ON	NEXT ASSY FINAL ASSY
APPLICATION		QTY REQD

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA.....SUB-ASSY MRA.....MAJOR REPL ASSY
MA.....MODULE ASSY CA.....COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ± .030 XX ± .020 XXX ± .010 ANGLES ± 0° 30'
MATERIAL
APPLIED FINISH

DRAWN	J. HALLAM	NOV 3, 64
CHECK	T. HANSELL	0365
ENGR		3-23
APPR		65
APPROVED		
APPROVED		
R&D	7-13-65	
DRW # 149		

DANA LABORATORIES INC.
SANTA ANA, CALIF.

P.C. BD ASSY-
AC/DC CONVERTER, FILTER

CODE IDENT NO.	SIZE		
	C	400206	B
SCALE 2/1	WEIGHT	SHEET 1 OF 2	

⚠1 CAPACITORS INDICATED ARE PART OF .5% MATCHED PAIR.

NOTES: UNLESS OTHERWISE SPECIFIED

B | 400206

386-09 LIETZ 1118 TOPFLIGHT 10-62

INSTRUCTIONS

FOR

INPUT FILTERS

MODEL 50, 55 And 58

INTRODUCTION

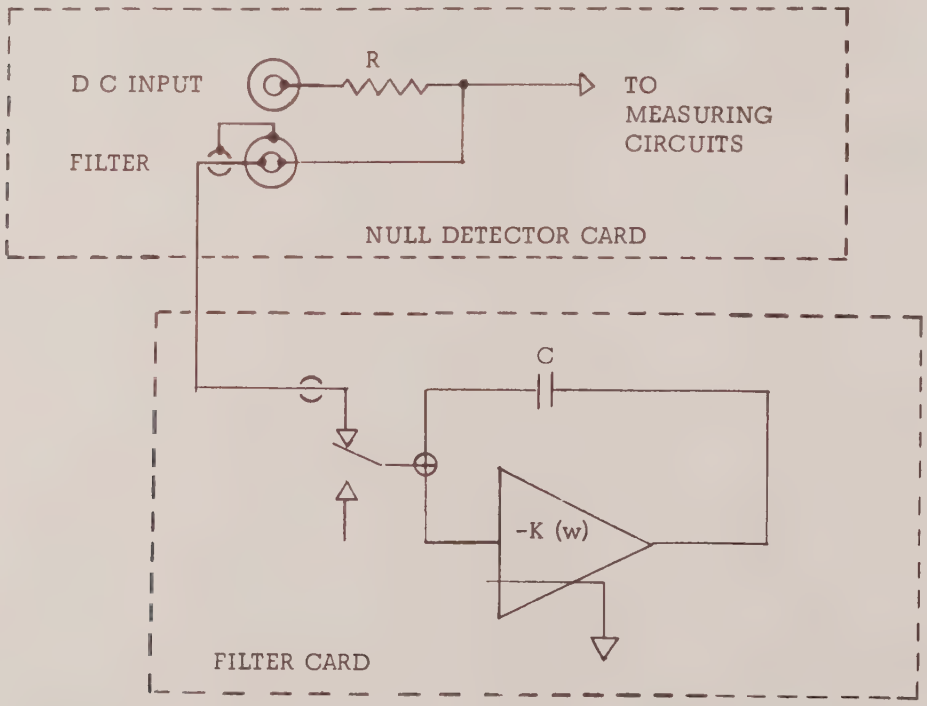
The Models 50, 55 and 58 are input filters designed for use with Dana Series 5600 Digital Voltmeters. When installed in a DVM which is properly wired, these filters allow precise DC voltage measurements to be made in the presence of line frequency hum or other superimposed AC signals. Except for balance time, the operation of the digital voltmeter is not disturbed by the filter.

DESCRIPTION

The Models 50, 55 and 58 Input Filters are all solid-state cards designed for use with Dana Series 5600 Digital Voltmeters.

Models 55 and 58 are nearly identical functionally; the Model 55 has fixed feedback components and the Model 58 has two sets of components which can be individually switch selected. Model 50 is a passive one-pole filter. All are switch selectable from the DVM front panel.

Functionally, the Models 55 and 58 are connected as a critically damped 3 pole capacitance multiplier. This circuit is combined with the input divider output resistance to form an active RC filter network. The amplifier gain -K(w) increases the effective value of C proportional to the cube of the input frequency.



In the Model 58 Filter the gain of the amplifer is switched by changing the feedback network that accurately establishes the gain characteristic -K(w).

In the Model 50 Filter the capacitor is grounded, yielding a one section passive RC filter.

SPECIFICATIONS

	MODEL 50	MODEL 55	MODEL 58	
AC Rejection				
60 cps and above	37 db min	37 db min	37 db min	80 db min
300 cps and above	51 db min	80 db min	80 db min	100 db min
Settling time to within 0.01% with up to 100 k source resistance	2 sec	200 msec	200 msec	950 msec
Maximum source resistance	1 megohm	1 megohm	1 megohm	1 megohm
Cutoff rate	6 db/octave	18db/octave	18db/oct	18 db/oct
AC input impedance				
10 v range	900 k ohms min	900 k ohms min	900 k ohm min	900 k ohms min
100 and 1000 v ranges	9 megohms min	9 megohms min	9 megohm min	9 megohms min

In Models 55 and 58 circuitwise, Q3 is a logical inverter. Q7, Q9 drive the Filter in/out relay and Q13 serves as a switch connecting C7 to the "Timeout" circuit in the DVM, increasing ranging and polarity delays to approximately 1.5 times the filter settling time. The balance of the transistors Q2, Q4, Q5, Q6, Q10, Q11, Q8, and Q9, comprise the amplifier. In the Model 58 Filter the switch changes C2, C4, C9 and C7 to the appropriate value for the selected 60 cycle rejection.

The Model 58 Filter 37/80db Switch is located on the Printed Circuit Card and is selected with the right hand door open. The UP position gives the user 80db rejection and the DOWN position allows the user to use the faster 37db section.

OPERATION

When the filter is properly installed in a Model 5600 DVM, it is activated by a two-position switch located in the center of the right door.

Installation in all current voltmeters is accomplished by slipping the filter card into the proper slot (see Page 3.4 of the basic DVM manual), seating it firmly and attaching the coaxial jumper between the null detector and filter.

When using the filter, time must be allowed after each input change for the filter to settle to the new value. If automatic range or polarity changes are required, this additional time is automatically provided by increasing the period of the internal "time Out" circuit. If no range or polarity changes are involved, the operator must wait until the reading becomes stable.

The Model 58 Filter 37/80 db switch is located on the printed circuit card and is selected with the right-hand door open. The up position gives the user 80 db rejection and the down position allows the user to use the faster 37 db section.

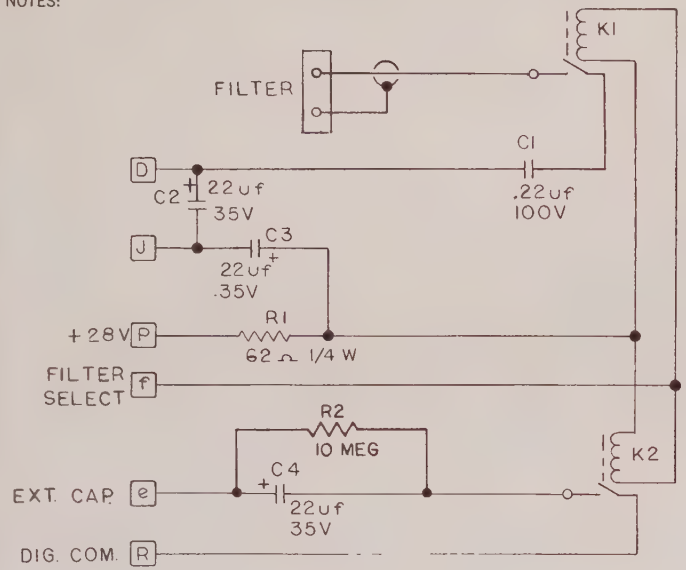
FILTER - MODEL 50
SPARE PARTS LIST

PART NO.	DESCRIPTION	QTY	REC'D SPARES	APPROX. PRICE
000620	Resistor - 62 ohm, 1/4W, 5%, Carbon	1	1	.15
110002	Capacitor - 22uf, 35V, Tantalum	3	1	3.80
120044	Capacitor - .22uf, 200V, 5%, Mylar,	1	1	
310013	Relay - SPST Glass Reed, Wheelock #260 -1A124	2	1	6.50

DANA FILTER - SPARE PARTS LIST
MODEL 55
Less 5% Carbon Resistors

PART NO.	DESCRIPTION	QTY	REC'D SPARES	APPROX. PRICE
010166	Resistor - 887K, RN65B, Metal Film	1	1	1.35
010067	Resistor - 442K, RN60B, Metal Film	1	1	.60
101175	Capacitor - 220pf, Ceramic Disc	1	1	.15
110001	Capacitor - 6.8uf, 35V, Tantalum	2	1	2.40
110002	Capacitor - 22uf, 35V, Tantalum	1	1	3.80
110006	Capacitor - 100uf, 10V, Tantalum	1	1	3.75
110023	Capacitor - 2 uf, 35V, Tantalum, ±10%	1	1	1.65
120040	Capacitor - .012uf, 1200V, 5%, Polystyrene	2	1	
120041	Capacitor - .024uf, 1200V, Polystyrene	1	1	
121146	Capacitor - .0047uf, 100V, Mylar	1	1	.30
121393	Capacitor - .22uf, 100V, Mylar	1	1	.60
200005	Transistor - Type T. I. 415	5	1	1.75
200011	Transistor - Type 009	1	1	10.00
200022	Transistor - Type -12	2	1	4.50
201084	Transistor - 2N1304	2	1	1.00
201085	Transistor - Type 005	2	1	1.60
211083	Diode - IN662	15	2	.50
220004	Diode - Zener, IN961B	1	1	4.00
221177	Diode - Zener, 1/4M2.4AZ10	1	1	2.25
310011	Relay - Babcock #BR16	1	1	42.00

NOTES:



430222 A

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

400346	5600	—	—
NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA..... SUB—ASSY MRA.....MAJOR REPL ASSY
MA..... MODULE ASSY CA.....COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN	A MENDOZA	10-29-64
CHECK	[illegible]	30 OCT 64
ENGR	[illegible]	30 OCT 64
APPR		

APPROVED

APPROVED

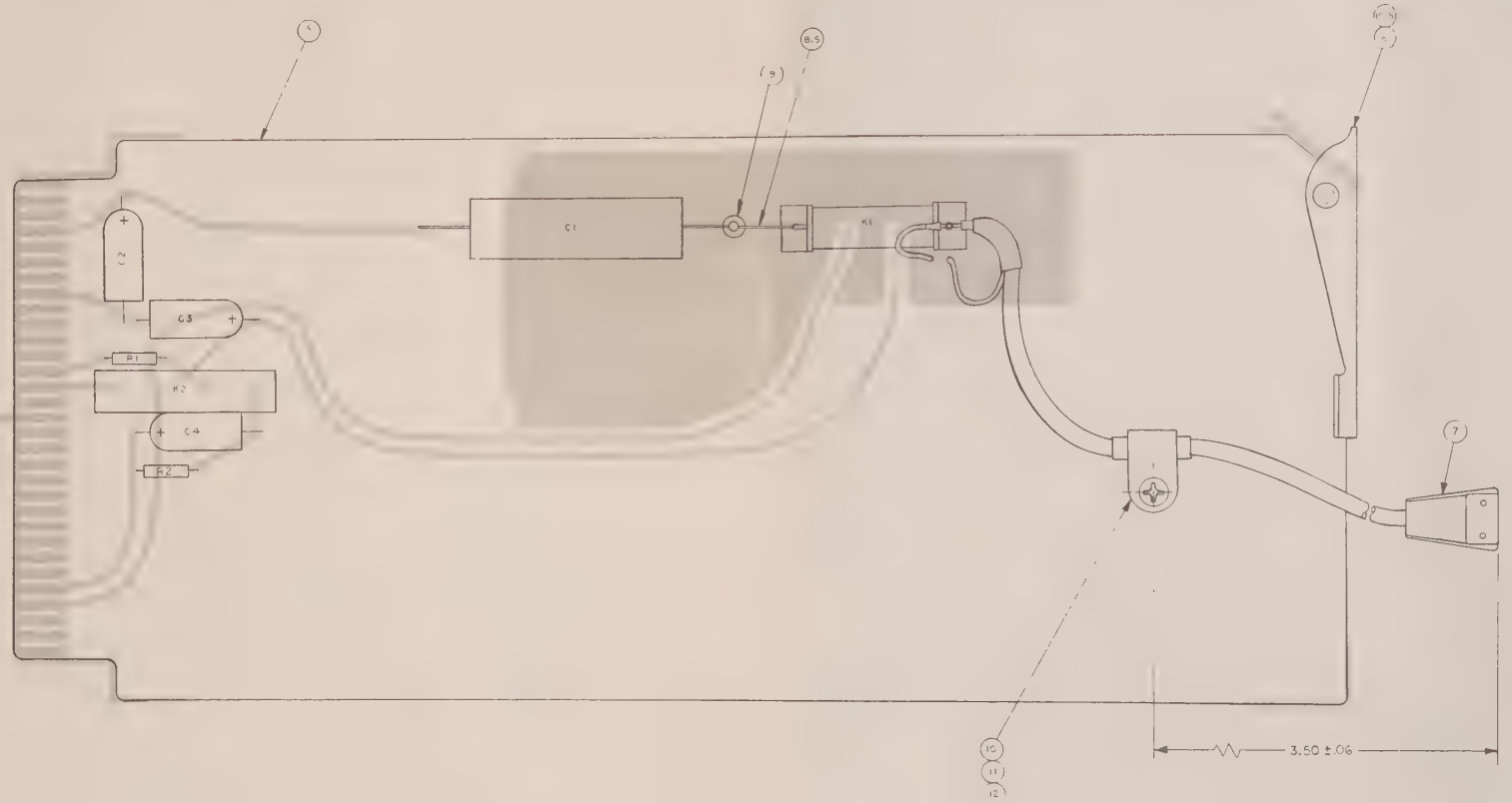
REL 30 OCT 64
DEN 63 [illegible]

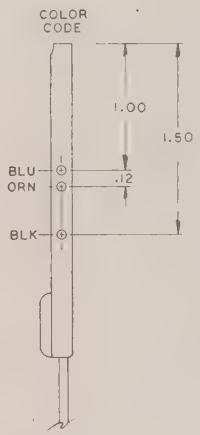
DANA LABORATORIES INC.
SANTA ANA, CALIF.

SCHEMATIC - 37db PASSIVE FILTER

CODE IDENT NO.	SIZE	
	B	430222 A
SCALE NONE	WEIGHT	SHEET 1 OF 1

586-00 LIETZ 1118 TOPFLIGHT 10-62





K2	4 3	MCI "E 124 S
K1	4	260-1A-24
C4	2	22 UF/35 V
C3	2	22 UF/35 V
C2	2	22 UF/35 V
C	3	.22 UF/200 V
R2	0	10 MEG
R1	1	82Ω 1/4W
REF DES	BOM ITEM	VALUE

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
5.1	410332 C
7.0	450398 7
8.0	457336 7
8.5	500004
9.0	h00030
10.0	c13050
10.5	c10019
11.0	C15559
12.0	417005

QTY REQD	SYM	ITEM NO	GOV'T IDENT NO	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
LIST OF MATERIALS OR PARTS LIST						

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA.... SUB-ASSY MRA.. MAJOR REPL ASSY
MA.... MODULE ASSY CA..... COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX .020, XXX ± .010
ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN	JOE HALLAM	NOV 3 1964
CHECK		12-6-65
ENGR		12-7-65
APPR		

APPROVED

APPROVED

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

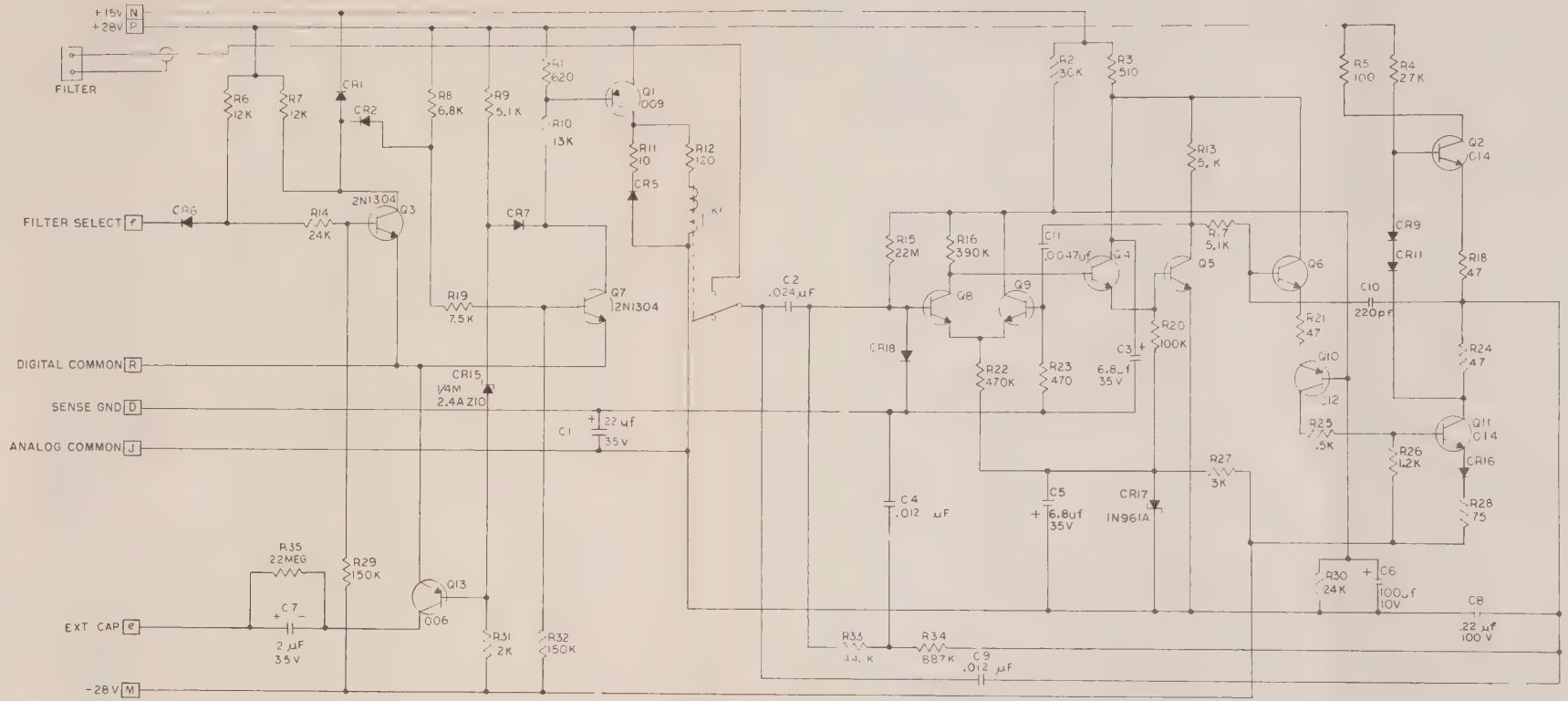
P.C. BD ASS'Y -
PASSIVE FILTER, MARK II

CODE IDENT NO.	SIZE		
	D	400346	C
SCALE 2/1	WEIGHT		SHEET 1 OF 1

C 400346

NOTES:

586-00 LIETZ 1030 TOPFLIGHT 4-64



5 HIGHEST REFERENCE DESIGNATORS:
C11 CR17
R35 Q13
4 MISSING REFERENCE DESIGNATORS:
Q12
CR3,4,8,10,12,13,14
3 ALL TRANSISTORS TI415.
2 ALL RESISTORS 1/4W, 5%.
1 ALL DIODES IN662
NOTES: UNLESS OTHERWISE NOTED.

QTY REQD	SYM	ITEM NO	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
					LIST OF MATERIALS OR PARTS LIST	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ±.030 XX ±.020 XXX ±.010 ANGLES ±0°30'
MATERIAL NONE
APPLIED FINISH NONE

DRAWN D. Harris 6 AUG 1964
CHECK
ENGR
APPR
APPROVED
APPROVED

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC, ACTIVE FILTER-FIXED 37DB

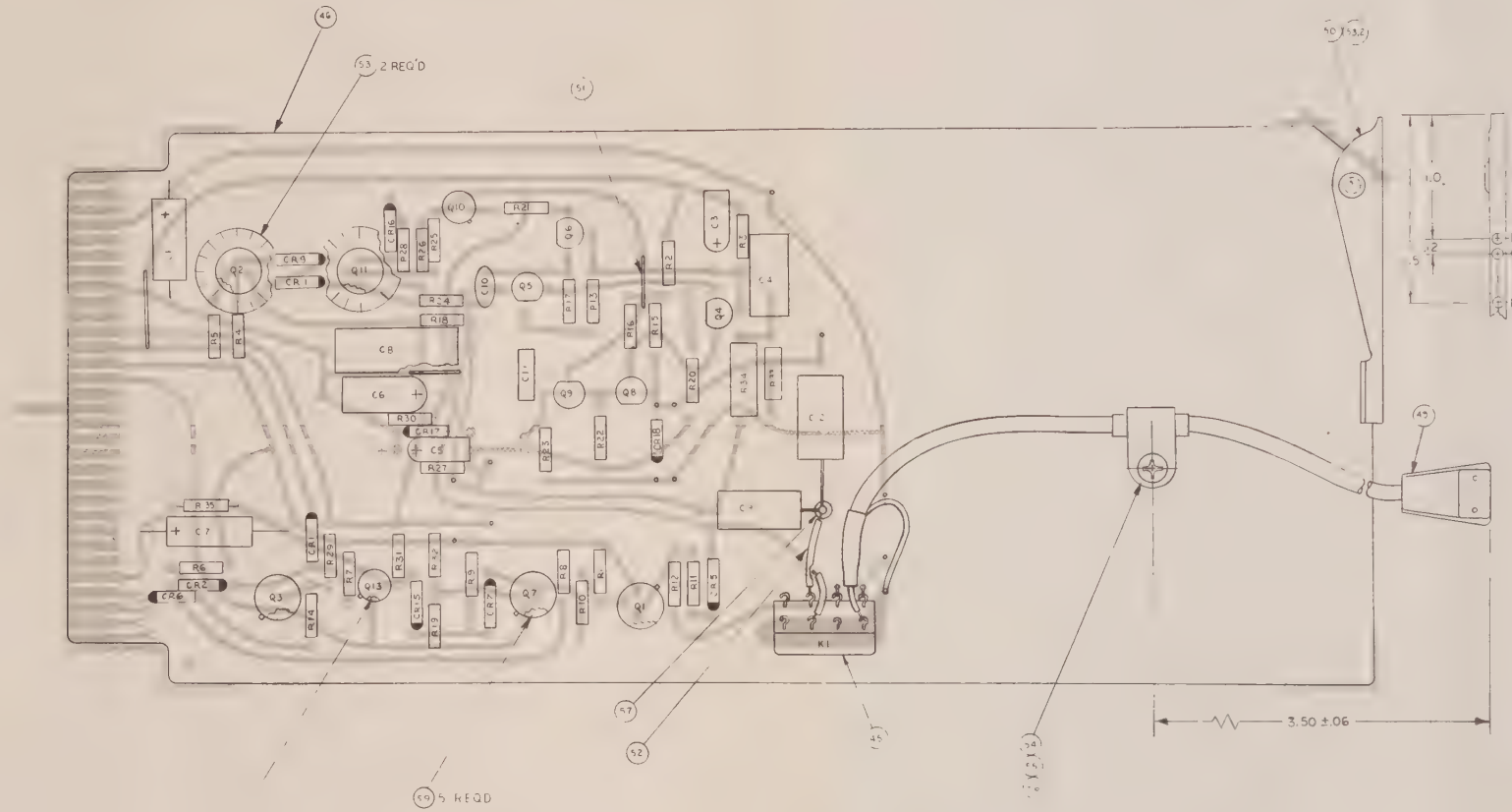
CODE IDENT NO. —— SIZE D 430153 E
SCALE NONE WEIGHT —— SHEET 1 OF 1

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA — SUB-ASSY MRA — MAJOR REPL ASSY
MA — MODULE ASSY CA — COMPLETE ASSY

586-00 LIETZ 1090 TOPFLIGHT 4-64

E 430153



C4	12	.012 UF/1200 V
C_	29	6.8 UF/35V
C_	34	.024 UF/100 V
C_	30	22 UF/35 V
R35	11	10 MEG
R34	26	68 K
R33	27	442 K
R32	10	1 K
R31	5	1.0 K
R30	12	4 K
R29	10	150 K
R28	24	75 Ω
R27	14	3K
R26	6	1.2K
R25	9	1.5 K
R24	17	47 Ω
R23	18	47 Ω
R22	19	4.7 K
R21	3	4 K
R20	1	100 K
R19	20	1 K
R18	4	4 Ω
R17	21	5.1K
R16	16	390K
R15	11	1 M
R14	12	24K
R13	21	5.1 K
R12	5	20 K
R11	1	10 Ω
R10	8	1.2 K
R9	2	5. K
R8	23	2.8 K
R7	7	1 M
R6	7	1 Ω
R5	22	10 Ω
R4	13	27 K
R3	20	1 Ω
R2	15	30 K
R1	22	620 Ω
REF DES	PART NO.	VALUE

Q13	41,3	006
Q1	39 2	4
Q10	39	0 E
		TI
		TI 41
		2N1304
Q6	39.2	0 4
Q5	39	0 9
CR18	42	IN662
CR17	43	IN2618
CR16	42	IN662
CR15	44	IN4001
CR14	42	IN662
CR9	42	IN662
CR7	42	IN662
CR6	42	IN662
CR5	42	IN662
CR2	42	IN662
CR1	42	IN662

C11	35	.0047 UF/100V
C10	28	220 PF
C9	33	.012 UF/1200 V
C8	36	.22 UF/100 V
C7	32	2 UF/35V
C6	31	100 UF/10 V
C5	29	6.8 UF/35V
REF DES	PART NO.	VALUE

CROSS REFERENCE CHART

ITEM NO.	PART NO.
45	310011
46	410121
49	450388
50	451036
51	500064
52	501376
53	600076
54	610019
53.2	610950
54	611630
55	615056
56	600030
57	920006
58	920007
59	920007

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS 1/4 W. 5%

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
					LIST OF MATERIALS OR PARTS LIST	

5600 SERIES	—	REF
NEXT ASSY	USED ON	NEXT ASSY FINAL ASSY
APPLICATION		QTY REQD

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA—SUB—ASSY MRA—MAJOR REPL ASSY
MA—MODULE ASSY CA—COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS X ± .030 XX ± .020 XXX ± .010
ANGLES ± 0° 30'

MATERIAL SEE B/M
APPLIED FINISH

DRAWN	[illegible]	NOV 17 1964
CHECK	[illegible]	6 30 65
ENGR	G GAUFITE	7-2 65
APPR		
APPROVED		
APPROVED		

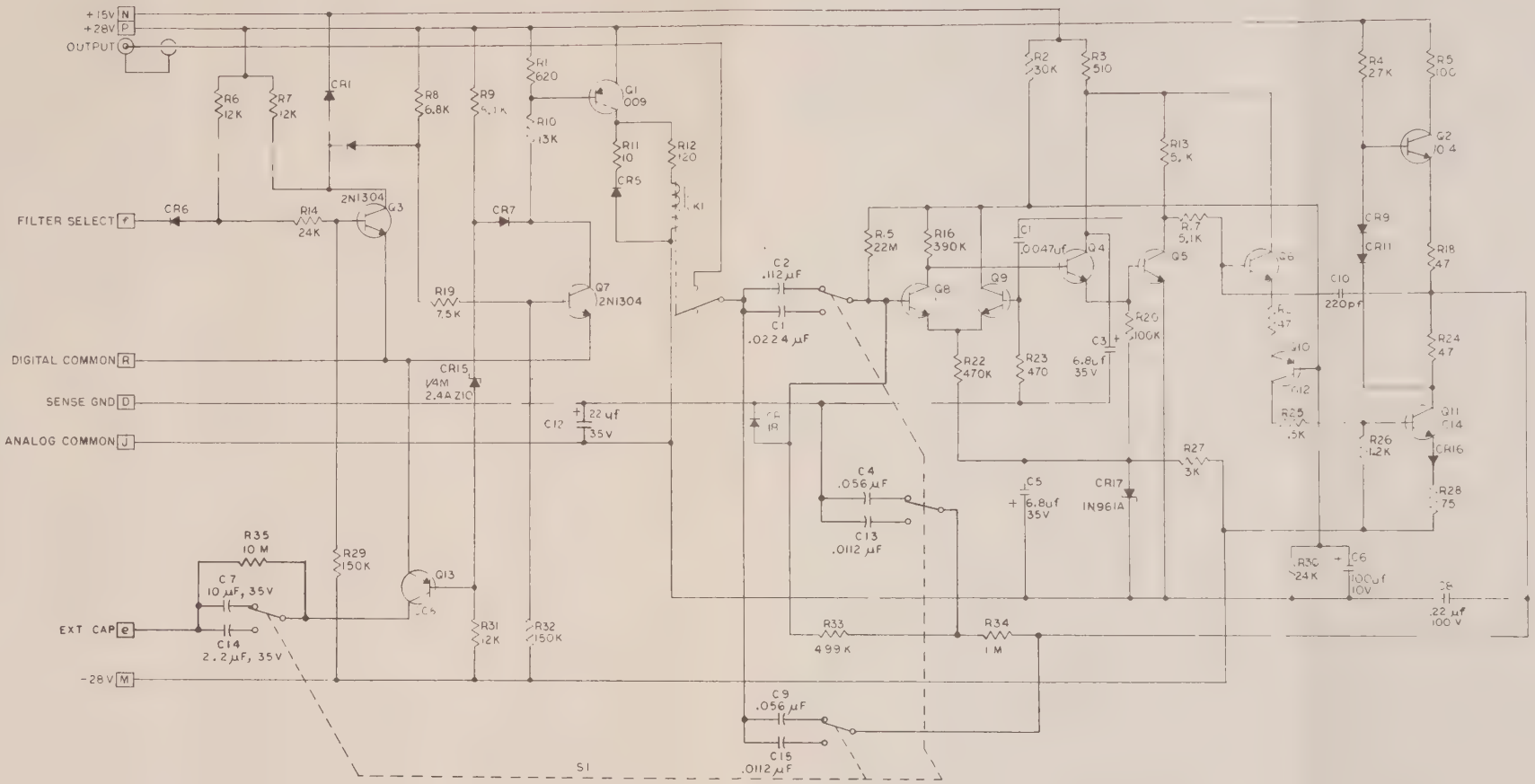
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSY—37db
FIXED ACTIVE FILTER

CODE IDENT NO	SIZE		
	D	400347	F
SCALE 2/1	WEIGHT		SHEET 1 OF 1

400347

566-00 LIETZ 1030 TOPFLIGHT 4 64



3 ALL TRANSISTORS T1415.
2 ALL RESISTORS 1/4W 5%.
1 ALL DIODES IN662
NOTES: UNLESS OTHERWISE NOTED.

QTY REQD	SYM	ITEM NO	GOV'T IDENT NO	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION

LIST OF MATERIALS OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS X ± .030 XX ± .020 XXX ± .010 ANGLES ± 0° 30'

MATERIAL

APPLIED FINISH

DRAWN
CHECK
ENGR
APPR
APPROVED
APPROVED

Released 12 Dec 66 DRN 96

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

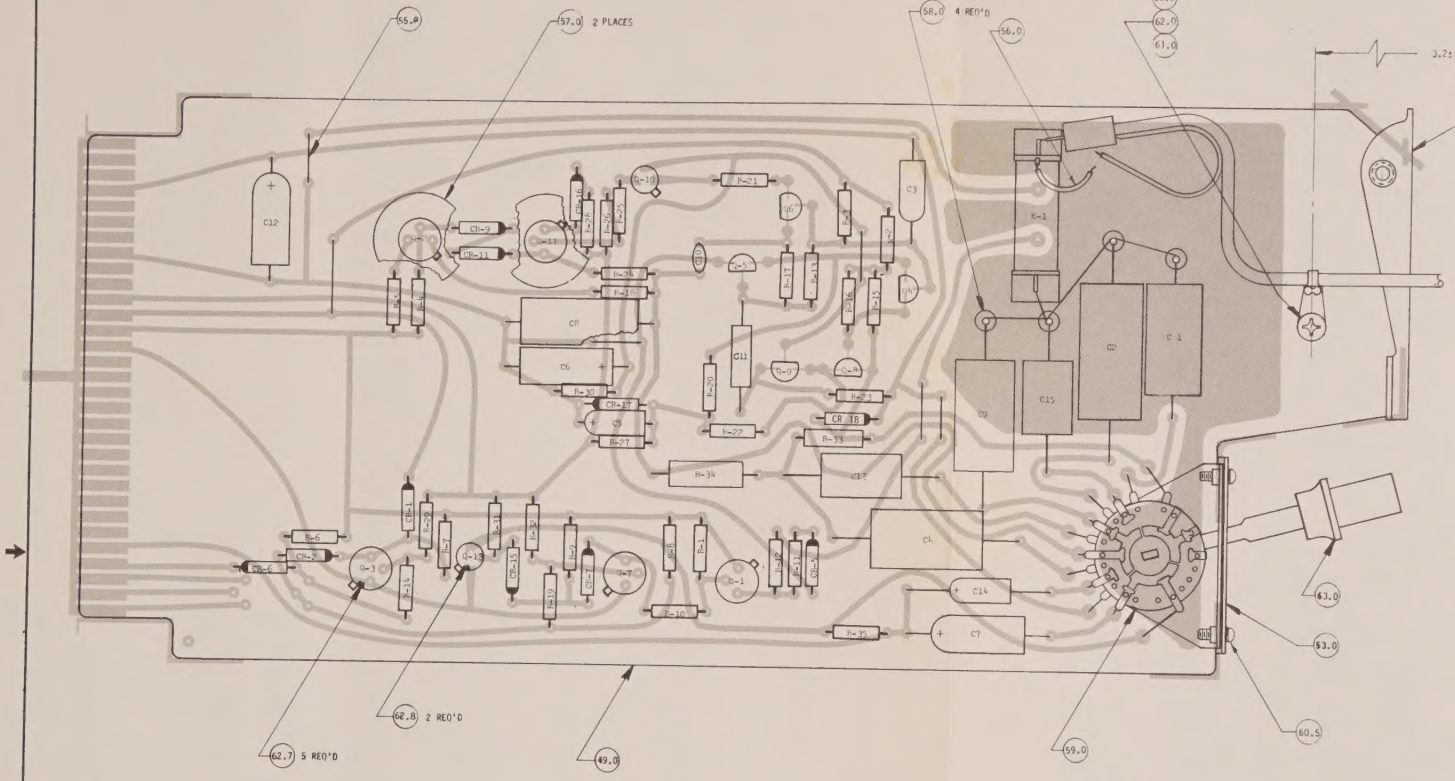
SCHEMATIC, ACTIVE FILTER, 37 DB - 80 DB

CODE IDENT NO. —
SIZE D
430220
SCALE —
WEIGHT —
SHEET 1 OF 1

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA — SUB-ASSY MRA MAJOR REPL ASSY
MA — MODULE ASSY CA — COMPLETE ASSY

430220



CROSS REFERENCE CHART	
B/M Item	Part No.
49.0	410141 B
52.0	450388
53.0	450575
54.0	451036
55.0	500004
56.0	501226
57.0	600016
58.0	600030
59.0	600171
59.5	610019
60.0	610050
60.5	610189
61.0	611630
62.0	615056
62.7	920006
62.8	920007
63.0	920098

REF DES	B/M ITEM	DESCRIPTION
CR9	45.0	1N662
CR7	45.0	1N662
CR6	45.0	1N662
CR5	45.0	1N662
CR2	45.0	1N662
CR1	45.0	1N662
C15	34.0	.012 MFD/200V
C14	33.0	2.2 MFD/35V
C13	34.0	.012 MFD/200V
C12	30.0	22 MFD/35V
C11	35.0	.024 MFD/200V
C10	28.0	220 PF
C9	36.0	.065 MFD
C8	39.0	.22 MFD/100V
C7	32.0	10 MFD/35V
C6	31.0	100 MFD/10V
C5	29.0	6.8 MFD/35V
C4	36.0	.065 MFD/200V
C3	29.0	6.8 MFD/35V
C2	37.0	.13 MFD/100V
C1	38.0	.0047 MFD

REF DES	B/M ITEM	DESCRIPTION
R35	4.0	10 MEG
R34	25.7	1 MEG 1%
R33	25.8	499K 1%
R2	15.0	30K
R1	22.0	620 Ohms
Q13	44.5	006
Q11	42.2	014
Q10	42.0	012
Q9	40.0	TI415
Q8	40.0	TI415
Q7	43.0	2N1304
Q6	40.0	TI415
Q5	40.0	TI415
Q4	40.0	TI415
Q3	43.0	2N1304
Q2	42.2	014
Q1	41.0	009
K1	48.0	Relay P/N 310013
CR18	45.0	1N662
CR17	46.0	1N961 B
CR16	45.0	1N662
CR15	47.0	2.4 AZ10 1/4M
CR11	45.0	1N662

REF DES	B/M ITEM	DESCRIPTION
R32	10.0	150K
R31	7.0	12K
R30	12.0	24K
R29	10.0	150K
R28	24.0	75 Ohms
R27	14.0	3K
R26	6.0	1.2K
R25	9.0	1.5K
R24	17.0	47 Ohms
R23	18.0	470 Ohms
R22	19.0	470K
R21	17.0	47 Ohms
R20	3.0	100 K
R19	25.0	7.5K
R18	17.0	47 Ohms
R17	21.0	5.1K
R16	16.0	390K
R15	11.0	22 MEG
R14	12.0	24K
R13	21.0	5.1K
R12	5.0	120 Ohms
R11	1.0	10 Ohms
R10	8.0	13K
R9	21.0	5.1K
R8	23.0	6.8K
R7	7.0	12K
R6	7.0	12K
R5	2.0	100 Ohms
R4	13.0	27K
R3	20.0	510 Ohms

QTY REQD	SYM	ITEM NO.	GOV'T IDENT NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	SPECIFICATION
LIST OF MATERIALS OR PARTS LIST						

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

SYMBOLS
APPLICABLE TO DANA LABORATORIES INC. ONLY
SA—SUB—ASSY MRA—MAJOR REPL ASSY
MA—MODULE ASSY CA—COMPLETE ASSY

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: X ± .030, XX ± .020, XXX ± .010
ANGLES ± 0° 30'

MATERIAL: SEE L/M

APPLIED FINISH

DRAWN: L. Dansett 9-2-65
CHECK: T. McMinn 9-17-65
ENGR: J. McLaughlin 9/20/65
APPR:
APPROVED
APPROVED
Rel. 9-19-65
Dft. # 160

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P. C. BOARD ASSY—
ACTIVE FILTER,
37 DB - 80 DB

CODE IDENT NO. | SIZE D | 400373 | C
SCALE 2/1 | WEIGHT | SHEET 5 OF 5

IC 400373

All resistors are to be carbon, 1/4W, ± 5%.
NOTES: Unless otherwise specified.

DAN-DD LIETZ 1090 TOPFLIGHT 6-64

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